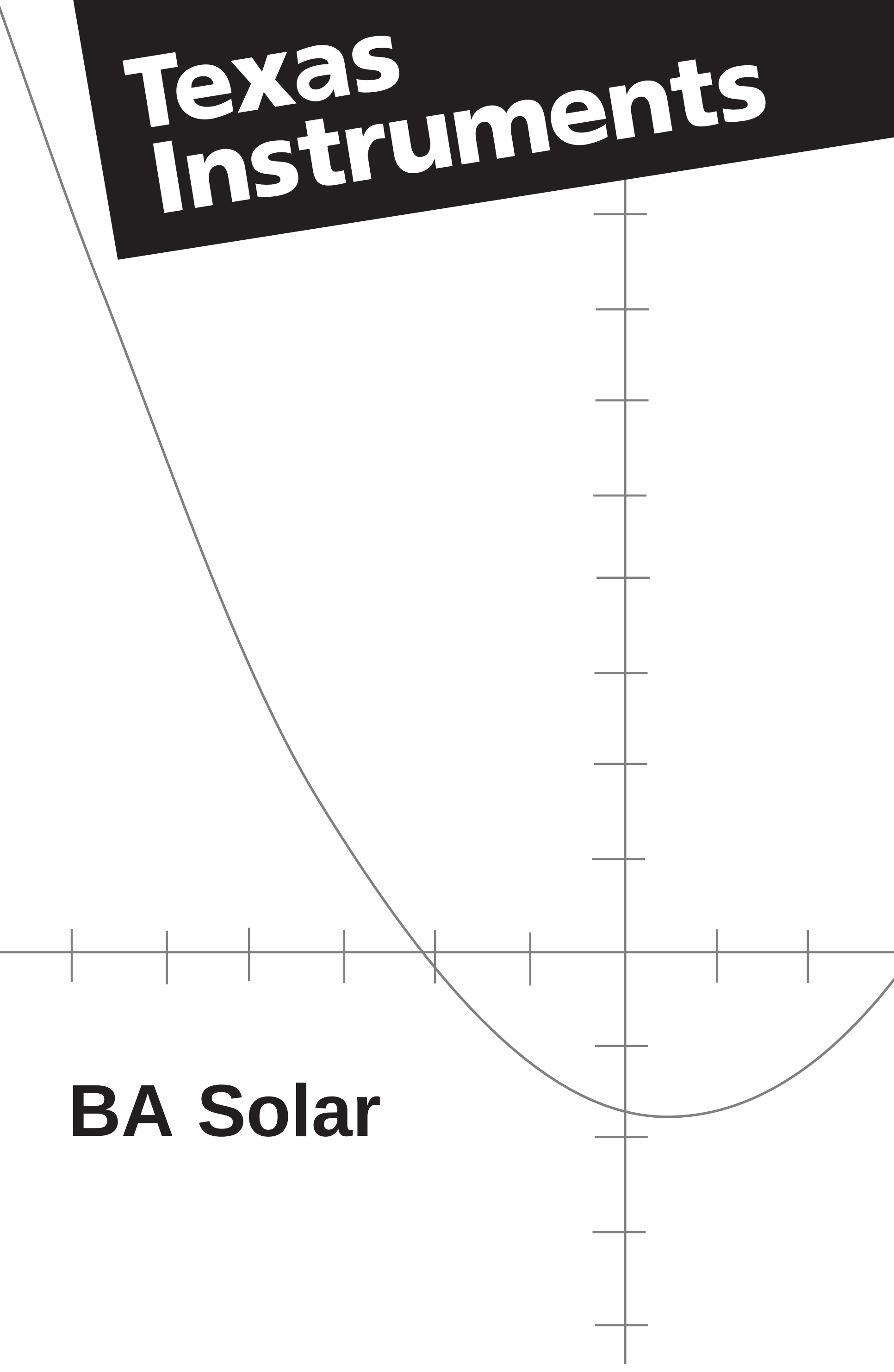
Texas Instruments



BA Solar

Key Index This indexed keyboard provides a quick page reference to the description of each key.

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[y'] 4-10 SUM 1-20	**[MEM]** 1-20 0 1-10	· 1-10	**[Mean]** 4-4 +/− 1-10	

Dual Function Keys Some calculator keys have dual functions, which are accessed by pressing the 2nd key just prior to the function key. Each key is described in the appropriate section of this manual.

TEXAS
INSTRUMENTS

BA Solar
FINANCIAL CALCULATOR
GUIDEBOOK

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- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/television technician for help.

Caution: Any changes or modifications to this equipment not expressly approved by Texas Instruments may void your authority to operate the equipment.

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The BA-SOLAR Business Analyst

The BA-SOLAR financial calculator has many useful, relevant functions for business people. It is an indispensable tool for helping you analyze and make decisions in application areas such as sales, real estate, loans, savings, and investments.

Unique Slide Case

The convenient slide case protects your calculator from dust and breakage.

***Anylite*™ Solar**

Your BA-SOLAR is totally light powered—it never needs batteries. And now, with TI's new *Anylite*™ technology, your calculator can function with less light than earlier solar calculators. The BA-SOLAR is dependable in any light!

Mathematical Operations

The BA-SOLAR can perform common operations involving reciprocals, powers and roots, and logarithmic functions, as well as simple arithmetic functions.

13-Digit Calculations

Although the display shows 10 digits, the calculator uses 13-digit values internally, increasing the accuracy of results.

Simple Business Functions

The BA-SOLAR can do calculations for percent, percent change, cost, selling price, gross profit margin, and markup and markdown.

Financial Functions

Your calculator helps you make time-and-money decisions related to mortgage, loan, bond, and savings problems. With the BA-SOLAR, you can solve for:

- Number of periods (N)
- Interest rate (%i)
- Present value (PV)
- Payment amount (PMT)
- Future value (FV)

You can also find the balance of a loan after a selected payment and the interest and principal of a single payment or over a selected range of payments. In addition, the BA-SOLAR lets you convert between annual percentage rates (APR) and annual effective rates (EFF).

Statistical Functions

You can use special keys in conjunction with the statistical registers to perform a variety of useful statistical operations, including mean, standard deviation, correlation, intercept, slope, and predicted value.

Error Correction

A variety of error correction techniques, including a "backspace key," saves you time by allowing you to correct errors in the middle of a problem rather than having to clear the calculator and start over.

Alternate Function Keys

To maximize the number of available functions of the BA-SOLAR, most of its keys perform additional functions when used in conjunction with the [2nd] key.

Display Formats

Although the calculator normally operates in standard, "floating-decimal" format, you can optionally select fixed-decimal format.

Display Indicators

Special indicators appear in the display to keep you informed about financial or statistical operations. These indicators tell you whether the calculator is set for beginning-of-period payments, or that the displayed result is:

- Principal for a single payment
- Interest for a single payment
- Summed principal over a range of payments
- Summed interest over a range of payments
- For the dependent variables (y values)
- For the independent variables (x values)

Special Note to BA-II Owners

If you have used a Business Analyst II (BA-II), you have a head start in learning to use your BA-SOLAR. The profit-margin, financial, and statistical functions are essentially the same on both calculators. However, the BA-SOLAR has some additional functions and enhancements.

Functions

This table lists the new or different functions of the BA-SOLAR and the appropriate chapter and page numbers.

Function	Key(s)	Chapter-Page
Clearing the calculator	AC/ON	1–2, 1–9
Correcting entry errors	→	1–13
Markup and markdown	2nd [MU]	2–7
Computation	CPT	2–6, 2–7, 3–3, 3–7
Setting for annuity-due situations (beginning-of-period payments)	2nd [BGN]	3–6
Monthly interest	2nd [÷12]	3–12
Monthly payments	2nd [×12]	3–12
Converting to APR	2nd [►APR]	3–15
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Interest and principal	I/P	3–18
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Enhancements

Unlike the BA-II, the BA-SOLAR lets you use the RCL key to recall values from the mode registers. You can do this in the profit-margin mode or the financial mode. (Refer to pages 2–6, 2–7, 3–3, and 3–7.) To recall a value from the memory, you must press RCL [MEM] (page 1–20).

With the BA-SOLAR, you can use all five financial registers at the same time. The BA-II lets you use only four of the registers; the value in the fifth register has to be zero. For example, when working a loan or lease problem on the BA-II, the future value (FV) is zero. With a loan problem on the BA-SOLAR, FV can be a balloon payment; with a lease problem, FV can be a residual value.

Chapter 1: Getting Started

This chapter helps you to understand the general features of your calculator, such as the modes, the display, and arithmetic and mathematical functions.

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Turning the Calculator On and Off

The [AC/ON] key turns the calculator on. The calculator stays on as long as the *Anylite*™ solar power cells, located above the display, are exposed to light.

Turning the Calculator On

To turn the calculator on, expose the solar power cells to a light source and press the [AC/ON] key. When you press [AC/ON], 0. and the financial mode indicator (FIN) appear in the display, and the calculator is ready to be used.

With TI's new *Anylite*™ technology, your calculator can function in any normal reading light.

Note: Be sure the entire solar cell panel is exposed to light. Covering even a portion of the panel may cause the display to go blank.

Turning the Calculator Off

The calculator turns off automatically when the solar cell panel is no longer exposed to the light source, as when you slide the case over the top of the calculator. The display, any pending operations, and any values in memory or the mode registers are cleared.

Modes

Your calculator can operate in several different modes. Setting the calculator to a particular mode prepares it to perform special functions. Indicators in the display tell you the calculator's current mode. The available modes are financial, statistics, and profit margin.

MODE
Mode Key

Pressing the MODE key changes the calculator to the next mode in sequence. To set the calculator to a particular mode, press MODE repeatedly until the appropriate indicator is displayed.

Note: Changing to a new mode clears the contents of the mode registers.

You can do arithmetic, mathematical, and percentage operations in any mode. Some keys, however, can be used only in one particular mode.

Financial Mode

In this mode, you can solve financial problems dealing with number of payments or compounding periods, interest rate, present value, amount of payment, and future value. FIN appears in the display.

After you press AC/ON to turn the calculator on, the calculator is in the financial mode.

The keys (or key sequences) that you can use only in the financial mode are N, %I, PV, PMT, FV, 2nd [BGN], I/P, BAL, and P_1/P_2.

Statistics Mode

In this mode, you can enter statistical data and perform statistical calculations. STAT appears in the display.

The keys (or key sequences) that you can use only in the statistics mode are Σ+, 2nd [Σ−], 2nd [b/a], 2nd [x'], 2nd [y'], 2nd [Corr], 2nd [σ_{n-1}], and 2nd [σ_n].

Profit-Margin Mode

In this mode, you can solve fundamental business problems dealing with gross profit margins and markups. No mode indicator appears in the display.

The keys (or key sequences) that you can use only in the profit-margin mode are CST, SEL, MAR, and 2nd [MU].

The Display

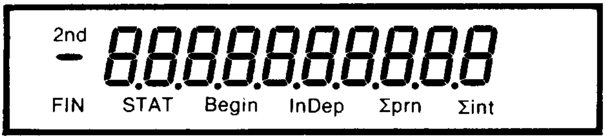
The display shows a maximum of 10 significant digits, although the calculator retains a maximum of 13 digits internally. To present additional information about the calculator, special indicators may also appear in the display.

Numeric Display

The display allows the entry and display of 10-digit numbers (with a maximum of nine digits to the right of the decimal). Commas separate large numbers into thousands, etc. (such as 44,444,444).

The minus sign indicates that the number in the display is negative.

Display Indicators



Indicator	Meaning
2nd	The calculator will access the second function of the next key pressed. This indicator appears when you press [2nd].
FIN	The calculator is in the financial mode.
STAT	The calculator is in the statistics mode.

Display Indicators (Continued)

These indicators are displayed only in the financial or statistics mode. The key functions that are associated with these indicators are presented in Chapters 3 and 4.

Indicator	Meaning
Begin	The calculator computes annuities as beginning-of-period payments, rather than end-of-period payments. (Displayed only in the financial mode.)
prn	The value in the display is the principal for a single payment. (Displayed only in the financial mode.)
int	The value in the display is the interest for a single payment. (Displayed only in the financial mode.)
Σprn	The value in the display is the summed principal over a range of payments. (Displayed only in the financial mode.)
Σint	The value in the display is the summed interest over a range of payments. (Displayed only in the financial mode.)
Dep	The displayed result is for the dependent variables (y values). (Displayed only in the statistics mode.)
InDep	The displayed result is for the independent variables (x values). (Displayed only in the statistics mode.)

Display Formats

In floating-decimal format, all non-zero digits to the right of the decimal point are displayed. You can set the number of decimal places displayed in the result. Sometimes, however, unusually large or small results are displayed in scientific notation.

Floating-Decimal Format

The calculator normally displays numbers in "standard" floating-decimal format, in which numbers are displayed in the range −9,999,999,999 to −0.000000001, 0, or 0.000000001 to 9,999,999,999. (Any results outside of this range are displayed in scientific notation.)

The calculator is always in floating-decimal format when you turn it on.

[2nd] [Fix] Fixed-Decimal Key Sequence

The [2nd] [Fix] key sequence enables you to set the number of decimal places displayed in a result. By changing the display format, you can convert a number from one format to another.

- To set the number of decimal places, press [2nd] [Fix] and then press the appropriate digit key ([0]–[9]).
- To remove the fixed-decimal setting and restore floating-decimal format, press [2nd] [Fix] [•].

If a result has more than the selected number of decimal places, the displayed number is rounded. If a result has fewer than the selected number of decimal places, trailing 0's are added.

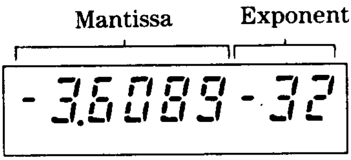
Example

Enter 55555.55555 in floating-decimal format, and then set the display format to two decimal places.

Procedure	Press	Display
Clear calculator.	[AC/ON]	0.
Enter number.	55555.55555	55,555.55555
Set decimal places.	[2nd] [Fix] 2	55,555.56
Restore floating-decimal format.	[2nd] [Fix] [•]	55,555.55555

Scientific Notation

If the result of a calculation is too large or too small to be displayed in the normal format, it is displayed in scientific notation. In scientific notation, a result is expressed as a base value (mantissa) times 10 raised to a power (exponent).



Display	Scientific	Floating Decimal
6.8765 12	6.8765×10^{12}	6,876,500,000,000
2.1 – 11	2.1×10^{-11}	0.000000000021

Second Functions

The calculator is designed to provide a wide variety of mathematical operations without overcrowding the keyboard. The main function of each key is marked on the key itself. Many of the keys, however, can perform more than one function. The $\boxed{\text{2nd}}$ key gives you access to these second functions.

$\boxed{\text{2nd}}$ Second Function Key

The $\boxed{\text{2nd}}$ key enables you to perform the second functions that are marked over a key.

To perform a second function, press $\boxed{\text{2nd}}$ and then press the appropriate function key. This guidebook shows a second function as a key symbol enclosed in brackets, whereas primary functions are shown inside a box.

For example, [$\sqrt{x}$] is the second function of the $\boxed{5}$ key.

- Press $\boxed{5}$ to enter the digit 5 into the display.
- Press $\boxed{\text{2nd}}$ [$\sqrt{x}$] to find the square root of a number.

Note: Although $\boxed{5}$ and [$\sqrt{x}$] are actually the same key, this guidebook uses key symbols that correspond to the function you are performing.

Points to Remember

A few points to remember when using second functions are:

- When you press $\boxed{\text{2nd}}$, **2nd** appears in the display until you press another key.
- If you press $\boxed{\text{2nd}}$ and then a key that does not have a second function, the key performs its normal function.
- If you accidentally press $\boxed{\text{2nd}}$, press $\boxed{\text{2nd}}$ again to cancel its effect.

Clearing the Calculator

The AC/ON key clears the calculator completely, including the memory and mode registers. Before pressing AC/ON, be sure that you do not want to retain any previous values. The CE/C key clears the calculator without affecting any values stored in memory or mode registers. The 2nd [CMR] key sequence clears the mode registers only.

AC/ON
All Clear/On Key

The AC/ON key clears the the calculator completely. Pressing the AC/ON key:

- Clears the display and all pending operations.
- Clears the memory and the mode registers.
- Sets the calculator to floating-decimal format and financial mode.

Clearing the Display and Pending Operations

Press the CE/C key to clear incorrect entries, error conditions, the display, or pending operations. CE/C does not affect the memory, the registers, or the display format.

- To clear an incorrect numerical entry, press CE/C once. (Refer to "Correcting Entry Errors" later in this chapter for more information.)
- To clear an error condition, indicated by Error in the display, press CE/C once. (Refer to Appendix A for more information on error conditions.)
- To clear the display and all pending operations, press CE/C twice.

2nd [CMR]
Clear Mode Registers

Pressing the 2nd [CMR] key sequence clears any values that have been stored in the mode registers. [CMR] is the second function of the CE/C key. Although second functions are usually marked over a key, [CMR] is marked to the left of the key.

Note: Changing to a new mode also clears the contents of the mode registers.

When solving more than one problem in a particular mode, you should always press 2nd [CMR] at the beginning of each problem. This clears any values from the previous problem that might cause incorrect results.

In the examples in this guidebook that require the calculator to be in a particular mode, the 2nd [CMR] key sequence is included.

Entering Numbers

The numeric entry keys enable you to enter the numerical data needed to perform calculations.

$\boxed{0}$-$\boxed{9}$ **Digit Keys**	The digit keys enter the digits 0–9 into the display. You can enter a maximum of 10 digits and a decimal point.
$\boxed{\cdot}$ **Decimal Point Key**	The $\boxed{\cdot}$ key enters a decimal point. For decimal numbers less than 1 and greater than – 1, a 0 automatically precedes the decimal point.
$\boxed{+/-}$ **Change Sign Key**	The $\boxed{+/-}$ key changes the sign of the number in the display, making it easy to enter negative numbers. To enter a negative number, first enter the number as a positive value and then press $\boxed{+/-}$.

Arithmetic Operations

The arithmetic keys enable you to perform the most commonly used mathematical operations: addition, subtraction, multiplication, and division. These operations are completed in the order that you enter them.

[+], [−], [×], [÷], [=] Arithmetic Keys

The [+], [−], [×], and [÷] keys perform the arithmetic operations of addition, subtraction, multiplication, and division. The [=] key completes all pending operations and displays the result of a calculation.

After you press [=] at the end of a calculation, the calculator is ready for you to enter a new problem.

Example 1

Calculate 5.43 + 10.6 ÷ 5.

Procedure	Press	Display
Clear calculator; select floating-decimal format.	[CE/C] [CE/C] [2nd] [Fix] [·]	0.
Enter the problem.	5.43 [+]	5.43
	10.6 [÷]	16.03
	5 [=]	3.206

Example 2

Calculate 5.43 × 10.6 − 5.1.

Procedure	Press	Display
Clear calculator; select floating-decimal format.	[CE/C] [CE/C] [2nd] [Fix] [·]	0.
Enter the problem.	5.43 [×]	5.43
	10.6 [−]	57.558
	5.1 [=]	52.458

Correcting Entry Errors

If you enter an incorrect number or press the wrong function key, you can always clear the calculation and begin again. In many instances, however, you can correct an entry error without clearing the entire calculation.

CE/C
Clear Entry/
Clear Key

The CE/C key clears incorrect entries or pending operations, as shown below.

- ► To clear a numerical entry, press CE/C once. Then enter the correct number.
- ► To clear all pending operations and begin the calculation again, press CE/C twice.

Note: When clearing an incorrect number, be sure to press CE/C before you press a pending operation key. (The pending operation keys are 2nd [y^x], 2nd [Δ%], ÷, ×, −, and +.) Pressing CE/C following any of these keys clears the calculation as if you had pressed CE/C twice.

Example

Calculate 10.1235 + 12.356, but enter the second number incorrectly.

Procedure	Press	Display
Clear calculator; select floating-decimal format.	CE/C CE/C 2nd [Fix] ·	0.
Enter first number and add.	10.1235 +	10.1235
Enter incorrect second number.	22.356	22.356
Clear the display.	CE/C	0.
Enter correct number and complete the calculation.	12.356 =	22.4795

[→]
Backspace Key

The [→] key removes the last digit or decimal point from the displayed number if you have not yet pressed an operation key ([+], [−], [×], [÷], etc.). This key is useful for correcting entry errors without having to clear the display and start again.

Example

Enter 59123.4 and correct it to 59124.4 using [→].

Procedure	Press	Display
Clear calculator; select floating-decimal format.	[CE/C] [CE/C] [2nd] [Fix] [·]	0.
Enter incorrect number.	59123.4	59,123.4
Remove the last two digits and the decimal point.	[→] [→] [→]	5,912
Complete the correct number.	4.4	59,124.4

(continued)

Correcting Immediate Functions

You can often correct an immediate function by performing its "reverse" operation. If you press $\boxed{\text{2nd}}$ [x^2], for example, you can correct the operation by pressing $\boxed{\text{2nd}}$ [$\sqrt{x}$].

Example

Find the reciprocal of 1.3, but press the $\boxed{\text{2nd}}$ [x^2] key sequence by mistake.

Procedure	Press	Display
Clear calculator; select floating-decimal format.	$\boxed{\text{CE/C}}$ $\boxed{\text{CE/C}}$ $\boxed{\text{2nd}}$ [Fix] $\boxed{\cdot}$	0.
Enter value.	1.3	1.3
Press $\boxed{\text{2nd}}$ [x^2] by mistake.	$\boxed{\text{2nd}}$ [x^2]	1.69
Correct the error by pressing the reverse function.	$\boxed{\text{2nd}}$ [$\sqrt{x}$]	1.3
Find reciprocal	$\boxed{\text{2nd}}$ [1/x]	0.769230769

x⇆y
x Exchange y Key

The x⇆y key enables you to exchange the values of x and y in universal powers, roots, and other calculations. If you enter x and y in the incorrect order, you can press x⇆y to reverse them before you complete the calculation. You can also use x⇆y to:

- Exchange the values of the minuend and subtrahend in subtraction or the values of the divisor and dividend in division.
- Exchange the new and old values in a percentage change calculation with 2nd [Δ%].

Example

Calculate 4^3, but enter the numbers in the wrong order.

Procedure	Press	Display
Clear calculator; select floating-decimal format.	CE/C CE/C 2nd [Fix] ·	0.
Enter y value.	3 2nd [y^x]	3.
Enter x value.	4	4
Exchange x and y.	x⇆y	3.
Calculate y^x.	=	64.

If you calculate 3^4 instead of 4^3, the result is 81.

Logarithms

Logarithms are useful for certain types of probability distributions and financial formulas. A variety of technical and theoretical calculations also require the use of logarithms. The logarithmic key sequences give you access to natural logarithms and natural antilogarithms.

2nd [lnx] Natural Logarithm Key Sequence

The 2nd [lnx] key sequence calculates the natural logarithm (base e where e = 2.718281828443) of the displayed number. The number must be positive; otherwise, an error condition occurs.

2nd [e^x] Natural Antilogarithm Key Sequence

The 2nd [e^x] key sequence calculates the natural antilogarithm of the displayed number. This is equivalent to the value of e raised to the power of the number in the display.

Example

Calculate ln 203.451 and $e^{-.69315}$.

Procedure	Press	Display
Clear calculator; select floating-decimal format.	CE/C CE/C 2nd [Fix] ·	0.
Natural log of 203.451.	203.451 2nd [lnx]	5.31542519
Raise e to the −0.69315 power.	.69315 +/− 2nd [e^x]	0.49999859

Reciprocals, Powers, and Roots

The BA-SOLAR enables you to calculate the reciprocal of a number, raise a number to a power, or find the root of a number. The square and square root key sequences calculate specific powers or roots. The universal power and root key sequences calculate any power or root within the range of the calculator.

2nd [1/x] Reciprocal Key Sequence

The 2nd [1/x] key sequence calculates the reciprocal of the displayed number, which is the same as dividing the number into one.

It is convenient to use a reciprocal when you need to divide one number (dividend) by another (divisor). If, because of previous calculations, the divisor already appears in the display, you can find the reciprocal of the displayed number and multiply by the other number. For example, $2 \div (5+3)$ could be solved by pressing 5 + 3 = 2nd [1/x] × 2 =.

2nd [x²] Square Key Sequence

The 2nd [x²] key sequence raises the displayed number to the second power, which is the same as multiplying the number by itself. The number can be any value whose square is in the range of the calculator.

2nd [√x] Square Root Key Sequence

The 2nd [√x] key sequence calculates the square root of the displayed number. The displayed number must be positive; otherwise, an error condition occurs. The result is always positive.

Example

Calculate $\frac{1}{2} \times 6^2 \div \sqrt{9}$.

Procedure	Press	Display
Clear calculator; select floating-decimal format.	CE/C CE/C 2nd [Fix] ·	0.
Find reciprocal.	2 2nd [1/x]	0.5
Find square.	× 6 2nd [x²]	36.
Find square root.	÷ 9 2nd [√x]	3.
Calculate result.	=	6.

(continued)

2nd [yˣ] Universal Power Key Sequence

The 2nd [yˣ] key sequence raises any positive number to any power within the range of the calculator. To find the xth power of a positive number:

1. Enter the number (y) that you want to raise to a power.
2. Press 2nd [yˣ].
3. Enter the power (x).
4. Press = or any key that completes the operation.

Example

Calculate $3.1897^{4.7343}$.

Procedure	Press	Display
Clear calculator; select floating-decimal format.	CE/C CE/C 2nd [Fix] ·	0.
Enter y value.	3.1897 2nd [yˣ]	3.1897
Enter x value.	4.7343	4.7343
Calculate y^x.	=	242.6067388

$\boxed{\text{2nd}}$ [y^x] Universal Root Key Sequence

The $\boxed{\text{2nd}}$ [y^x] key sequence calculates any root of any positive number within the range of the calculator. To calculate the xth root of a positive number:

1. Enter the number (y) whose root you want to find.
2. Press $\boxed{\text{2nd}}$ [y^x].
3. Enter the root (x).
4. Press $\boxed{\text{2nd}}$ [1/x].
5. Press $\boxed{=}$ or any key that completes the operation.

Example

Calculate $\sqrt[3.871]{21.496}$.

Procedure	Press	Display
Clear calculator; select floating-decimal format.	$\boxed{\text{CE/C}}$ $\boxed{\text{CE/C}}$ $\boxed{\text{2nd}}$ [Fix] $\boxed{\cdot}$	0.
Enter y value.	21.496 $\boxed{\text{2nd}}$ [y^x]	21.496
Enter x value.	3.871	3.871
Press reciprocal key sequence.	$\boxed{\text{2nd}}$ [1/x]	0.258331181
Calculate $\sqrt[x]{y}$.	$\boxed{=}$	2.208968514

Memory Operations

You can use the calculator's memory to store, sum, and recall a numeric value. Pressing AC/ON clears the memory and the mode registers.

The Memory

The memory can store any numeric value within the range of the calculator. You can use the memory to compare a value with the result of a later calculation or to recall a number that is used several times during a calculation. You can use the memory in any mode.

STO
Store Key

The STO key stores the displayed numeric value in the memory, replacing any value previously stored there.

When 0 is displayed, you can clear the memory by pressing STO, thereby storing a zero in memory.

SUM
Sum Key

The SUM key adds the displayed numeric value to the contents of the memory.

If you want to add a series of numbers to the memory, you should use STO to store the first number (thereby replacing any previous value), and then use SUM with the remaining numbers.

If you want to subtract the displayed value from the value in memory, you can press +/– (to change the sign of the displayed value) and then press SUM.

RCL [MEM]
Recall Memory Key Sequence

The RCL [MEM] key sequence displays (recalls) the number stored in the memory, without affecting the contents of the memory.

[MEM] is marked over the 0 key on your calculator because this key is part of the recall memory key sequence. While [MEM] is an alternate function of the 0 key, it is not used in conjunction with 2nd.

In the profit-margin and financial modes, you can use RCL to recall values from the mode registers. This is presented in Chapters 2 and 3.

Example

Add the following numbers to the memory: 50, 3.871, and 8.7652. Then, subtract 1.234 from the memory and recall the result.

Procedure	Press	Display
Clear calculator; select floating-decimal format.	CE/C CE/C 2nd [Fix] •	0.
Store 50 in memory (replacing any previous value).	50 STO	50.
Add 3.871 to the number in memory.	3.871 SUM	3.871
Add 8.7652 to the number in memory.	8.7652 SUM	8.7652
Subtract 1.234 from the number in memory.	1.234 +/− SUM	− 1.234
Recall the current number in memory.	RCL [MEM]	61.4022

Chapter 2: Business Functions

This chapter presents the keys that perform fundamental business functions. These functions are percentages, percentage change, and finding cost, selling price, profit margin, and markup.

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Percentage Calculations 2-2
Percentage Change Calculations 2-4
Gross Profit Margin and Markup Calculations 2-6

Percentage Calculations

A percentage represents a specific number of hundredths. For example, 50% is 50/100, which equals 1/2. Percentage calculations are useful in a wide variety of business and everyday applications.

$\boxed{\%}$
Percent Key

The $\boxed{\%}$ key automatically divides the number in the display by 100, which converts the number to its equivalent decimal percent. For example, if you enter 43.9 and press $\boxed{\%}$, 0.439 is displayed.

You can use $\boxed{\%}$ to calculate percentages, add-ons, discounts, and percentage ratios. The "principal amount" shown below is the number in the display when you begin the key sequence.

Key Sequence	Function
$\boxed{\times}$ n $\boxed{\%}$ $\boxed{=}$	Percentages—Calculates n% of the principal amount.
$\boxed{+}$ n $\boxed{\%}$ $\boxed{=}$	Add-ons—Calculates n% of the principal amount and adds the percentage to the number.
$\boxed{-}$ n $\boxed{\%}$ $\boxed{=}$	Discounts—Calculates n% of the principal amount and subtracts the percentage from the amount.
$\boxed{\div}$ n $\boxed{\%}$ $\boxed{=}$	Percentage Ratios—Divides the principal amount by n%.

Percentage Example

Calculate 4% of 453.

Procedure	Press	Display
Clear calculator; select floating-decimal format.	$\boxed{\text{CE/C}}$ $\boxed{\text{CE/C}}$ $\boxed{\text{2nd}}$ [Fix] $\boxed{\cdot}$	0.
Enter percentage.	453 $\boxed{\times}$ 4 $\boxed{\%}$	0.04
Calculate result.	$\boxed{=}$	18.12

Add-On Example

Calculate 1450 + 15% add-on.

Procedure	Press	Display
Clear calculator; select floating-decimal format.	CE/C CE/C 2nd [Fix] ·	0.
Calculate add-on amount.	1450 + 15 % =	1,667.5

Discount Example

Calculate 69.95 – 10% discount.

Procedure	Press	Display
Clear calculator; select floating-decimal format.	CE/C CE/C 2nd [Fix] ·	0.
Calculate discount amount.	69.95 − 10 % =	62.955

Ratio Example

29.5 is what percent of 25?

Procedure	Press	Display
Clear calculator; select floating-decimal format.	CE/C CE/C 2nd [Fix] ·	0.
Enter percentage and calculate result.	29.5 ÷ 25 % =	118.

Percentage Change Calculations

Certain types of values usually vary over a period of time. When you are comparing two of these values, you often need to know the percentage increase or decrease between the values.

2nd [Δ%] Percent Change Key Sequence

The 2nd [Δ%] key sequence calculates the percentage change between two values. To calculate the percentage change:

1. Enter the new value.

2. Press 2nd [Δ%].

3. Enter the old value.

4. Press =.

The percentage change is calculated by the formula:

$$\frac{\text{New value} - \text{Old value}}{\text{Old value}} \times 100$$

If the result is positive, there is a percentage increase. If the result is negative, there is a percentage decrease.

Example 1

Last year, your company had a net income of $100,000. This year, you expect a net income of $125,000. What is the percent increase?

Procedure	Press	Display
Clear calculator; select floating-decimal format.	CE/C CE/C 2nd [Fix] ·	0.
Enter new value (for this year).	125000 2nd [Δ%]	125,000.
Enter old value (for last year).	100000	100,000.
Calculate result.	=	25.

Example 2

A piece of equipment regularly sells for $9,420. If a salesperson offers to sell it to you for $8,478, what is the percent savings?

Procedure	Press	Display
Clear calculator; select floating-decimal format.	CE/C CE/C 2nd [Fix] ·	0.
Enter sale price (new value).	8478 2nd [Δ%]	8,478.
Enter list price (old value).	9420	9,420
Calculate result.	=	– 10.

The result is a 10% savings off the regular price.

Gross Profit Margin and Markup Calculations

Your calculator has several keys that can help you calculate the cost, selling price, gross profit margin, or markup for merchandise or services. To use any of these keys, the calculator must be in the profit-margin mode.

Gross Profit Margin Keys

These keys work together to find the cost, selling price, or gross profit margin.

- CST—Enters the cost.
- SEL—Enters the selling price.
- MAR—Enters the gross profit margin, which is the difference between selling price and cost, expressed as a percentage of the **selling price**.

$$\text{Gross Profit Margin} = \frac{\text{Selling Price} - \text{Cost}}{\text{Selling Price}} \times 100$$

- CPT—Computes the unknown value for gross profit margin problems.

To recall a value that you have entered or computed, you can press RCL and the appropriate key for the value you want to recall. For example, to recall the value for margin, press RCL MAR.

Performing Gross Profit Margin Calculations

If you know two of the values (cost, sell, or margin), you can find the unknown value by pressing the CPT key and the key representing the unknown value.

To calculate cost, selling price, or gross profit margin:

1. Clear the registers and enter the profit-margin mode (no display indicator).
2. Enter the two known values.
3. Press CPT and the key for the unknown value.

Markup Keys

These keys work together to find the cost, selling price, or markup.

- CST—Enters the original cost (before markup).
- SEL—Enters the selling price (after markup).
- 2nd [MU]—Enters the markup, which is the difference between selling price and cost, expressed as a percentage of the **cost**.

  $$\text{Markup} = \frac{\text{Selling Price} - \text{Cost}}{\text{Cost}} \times 100$$

  If the percentage is a positive value, there is a markup. The selling price is greater than the cost.

  If the percentage is a negative value, there is a markdown or discount. The selling price is less than the cost.
- CPT—Computes the unknown value for markup problems.

To recall a value that you have entered or computed, you can press RCL and the appropriate key for the value you want to recall. For example, to recall the value for markup, press RCL 2nd [MU].

Performing Markup Calculations

If you know two of the values (cost, sell, or markup), you can find the unknown value by pressing the CPT key and the key representing the unknown value.

To calculate cost, selling price, or markup:

1. Clear the registers and enter the profit-margin mode (no display indicator).
2. Enter the two known values.
3. Press CPT and the key (or key sequence) for the unknown value.

(continued)

Example: Determining Margin and Markup

The original cost of an item is $100, and the selling price is $125. Find the gross profit margin and the markup.

Procedure	Press	Display
Clear calculator and mode registers. Select two decimal places.	CE/C CE/C 2nd [CMR] 2nd [Fix] 2	0.00
Press MODE until no mode indicator is displayed.	MODE	0.00
Enter cost.	100 CST	100.00
Enter selling price.	125 SEL	125.00
Compute margin.	CPT MAR	20.00
Compute markup.	CPT 2nd [MU]	25.00

The gross profit margin is 20% of the selling price, or $25 (20% of $125).

The markup is 25% of the cost, or $25 (25% of $100). Notice that a 25% markup is the same as a 20% margin.

Example: Determining the Selling Price

If the cost is $100 and the margin is 20%, find the selling price.

Procedure	Press	Display
Clear calculator and mode registers. Select two decimal places.	CE/C CE/C 2nd [CMR] 2nd [Fix] 2	0.00
Press MODE until no mode indicator is displayed.	MODE	0.00
Enter cost.	100 CST	100.00
Enter percentage of gross profit margin.	20 MAR	20.00
Compute selling price.	CPT SEL	125.00

(continued)

Example: Determining the Cost

If the selling price is $125 and the markup is 25%, find the cost.

Procedure	Press	Display
Clear calculator and mode registers. Select two decimal places.	[CE/C] [CE/C] [2nd] [CMR] [2nd] [Fix] 2	0.00
Press [MODE] until no mode indicator is displayed.	[MODE]	0.00
Enter selling price.	125 [SEL]	125.00
Enter percentage of markup.	25 [2nd] [MU]	25.00
Compute cost.	[CPT] [CST]	100.00

Chapter 3: Financial Functions

This chapter presents the keys that are generally used in the financial mode, along with basic concepts regarding compound interest, time lines, annuities, and interest rates.

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Compound Interest

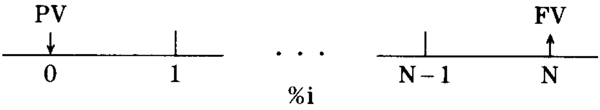
The value of an amount of money is affected by interest over a period of time. Compound interest is interest earned not only on the original amount of the principal, but also on the interest earned in previous compounding periods. A time line helps visualize a compound interest calculation.

Compounding Interest

Many lending institutions allow you to add the interest you earn to the principal. The interest you earn from the previous compounding period becomes part of the principal for the next compounding period.

Thus, when interest is compounded, it is added to the balance; you earn interest on this new balance.

The following time-line diagram illustrates a compound interest calculation.



Note: For compound interest calculations such as this, there is no payment involved; thus, the payment (PMT) is assumed to be zero. When the payment has a value other than zero, the calculator treats the problem as an annuity. Annuities are discussed later in this chapter.

Discounting Interest

When the compounding process is reversed, interest is discounted (removed). Discounting is used to compute the value at time zero (present value) of a future cash flow (future value).

For example, $121 is received after two years. What is the present value if the annual interest (or discount) rate is 10% compounded annually? The interest earned in each year is removed as shown below.

$\$121 \div (1 + 10\%) = \$110$

$\$110 \div (1 + 10\%) = \$100$

Thus, the present value of $121 received at the end of two years is $100, assuming a discount rate of 10% compounded annually.

Compound Interest Keys

In compound interest calculations, four keys are used to enter or calculate the values listed below.

- [N]—The total number of compounding periods.
- [%I]—The percent interest per compounding period.
- [PV]—The present value of a future amount. With a savings account, for example, PV represents what your money is worth today.
- [FV]—The future value of a present amount. With a savings account, for example, FV represents what your money will be worth in the future.

To recall a value that you have entered or computed, you can press [RCL] and the appropriate key for the value you want to recall. For example, to recall the present value, press [RCL] [PV].

[CPT] Computation Key

The [CPT] key computes the unknown value for compound interest problems.

Performing Compound Interest Calculations

To perform a compound interest calculation, you must know any three of the four values (N, %I, PV, or FV). You can then follow a procedure to find the unknown value.

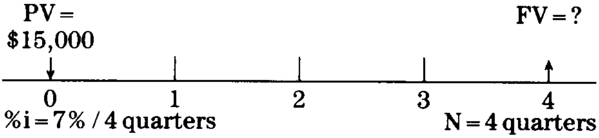
Procedure

Follow these steps to find the unknown value.

1. Clear the registers and enter the financial mode (FIN appears in the display).
2. Enter the three known values.
3. Press CPT and the key for the unknown value.

For compound interest calculations, the payment (PMT) must be zero. This value is set automatically when you press MODE to enter the financial mode or when you press 2nd [CMR] to clear the financial registers.

Example If you deposit $15,000 in a savings account that earns 7% interest compounded quarterly, what amount will be in the account at the end of one year?



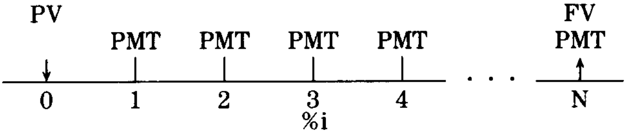
Procedure	Press	Display
Clear calculator and mode registers; select two decimal places.	CE/C CE/C 2nd [CMR] 2nd [Fix] 2	0.00
Press MODE until **FIN** is displayed.	MODE	0.00
Enter number of compounding periods.	4 N	4.00
Enter deposit.	15000 PV	15,000.00
Enter quarterly interest rate.	7 ÷ 4 = %i	1.75
Calculate amount after one year.	CPT FV	16,077.89

Annuities

An annuity is a series of equal payments made at regular time periods, with interest calculated at the end of each period. Time lines can show the differences between ordinary annuities and annuities due.

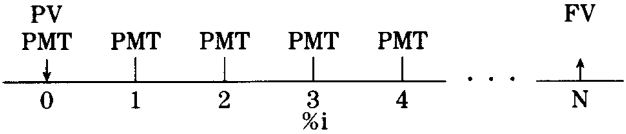
Ordinary Annuities

In ordinary annuities, payments occur at the end of each payment period. Most loans are in this category.



Annuities Due

In annuities due, payments occur at the beginning of each payment period. Most leases are in this category.



2nd [BGN] Beginning-of-Period Key Sequence

The 2nd [BGN] key sequence sets the calculator to compute for annuity-due problems (beginning-of-period payments).

When **Begin** is in the display, the calculator solves for beginning-of-period payments. When **Begin** is **not** in the display, the calculator solves for end-of-period payments.

Pressing 2nd [BGN] causes **Begin** to appear in the display. The beginning-of-period function is in effect until you cancel it (by pressing 2nd [BGN] again) or leave the financial mode, causing **Begin** to disappear from the display.

Note: If an annuity problem does **not** use beginning-of-period payments, be sure that **Begin** is not in the display before you compute the answer. Having **Begin** in the display has no effect on compound interest calculations in which no payment is involved.

Annuity Keys

In annuity calculations, five keys are used to enter or calculate the values listed below.

- N—The total number of payment periods.
- %i—The percent interest per payment period.
- PV—The present value of a series of payments plus the present value of FV. With a savings account, for example, PV represents an initial deposit (not including the first regular payment). With a loan, PV represents the loan amount.
- PMT—The amount of the regular payment. This value may be positive or negative, depending on the type of problem you are solving. This is explained on page 3-8.
- FV—The future value of a series of payments plus the future value of PV. With a savings account, for example, FV represents the final amount withdrawn from the account. With a loan, FV represents any extra payment (balloon) that must be made in addition to the last regular payment.

To recall a value that you have entered or computed, you can press RCL and the appropriate key for the value you want to recall. For example, to recall the present value, press RCL PV.

CPT Computation Key

The CPT key computes the unknown value for annuity problems.

- When **Begin** is **not** displayed, the CPT key computes the unknown value for ordinary annuities (annuities with end-of-period payments).
- When **Begin** is displayed, the CPT key computes the unknown value for annuities due (annuities with beginning-of-period payments).

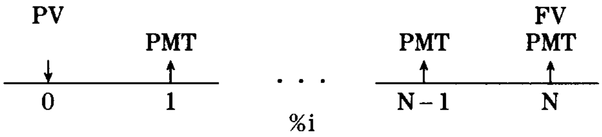
Determining Whether Payment Is Positive or Negative

In annuity problems, the present value and future value are always positive numbers. The payment amount, however, may be positive or negative, depending on the type of problem you are solving.

When Payment Is Positive

If payments are discounted backward, the payment amount is positive. This is the case in the following types of problems:

- Mortgages
- Loans
- Leases
- Bonds



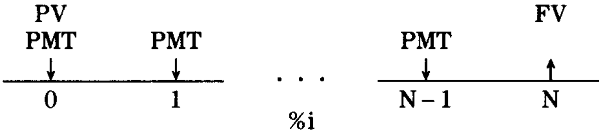
Note: Because the time line above shows end-of-period payments, it applies directly to mortgages, loans, and bonds. A time line for leases should show beginning-of-period payments.

These problems always have a present value, but they may or may not have a future value. (If there is no future value, FV = 0.)

The present value and payment flow in opposite directions; if one is an inflow, the other is an outflow.

When Payment Is Negative

If payments are compounded forward, the payment amount is negative. This is the case in savings problems.



These problems always have a future value, but they may or may not have a present value. (If there is no present value, PV = 0.)

The future value and payment are always opposite; if one is an inflow, the other is an outflow.

Performing Annuity Calculations

To perform an annuity calculation, you must know any four of the five values (N, %i, PV, PMT, or FV). You can then use a procedure to find the unknown value.

Procedure

Follow these steps to find the unknown value.

1. Clear the registers and enter the financial mode (**FIN** appears in the display).
2. If necessary, press [2nd] [BGN] to set the calculator for ordinary annuities or annuities due.
   - For ordinary annuities (end-of-period payments), press [2nd] [BGN] until **Begin** is **not** displayed.
   - For annuities due (beginning-of-period payments), press [2nd] [BGN] until **Begin** is displayed.
3. Enter the four known values.
4. Press [CPT] and the key for the unknown value.

While performing a calculation, the calculator clears the display and ignores any keyboard entries.

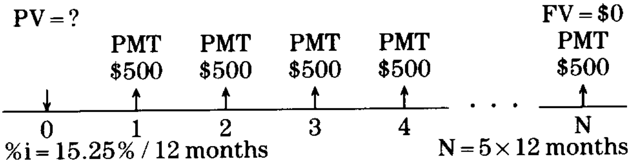
Note: As a general rule, interest rate calculations require more time than other calculations. However, if you use unrealistic values, the calculator may take several minutes before indicating an error condition. If this occurs, clear the calculation by pressing [AC/ON].

(continued)

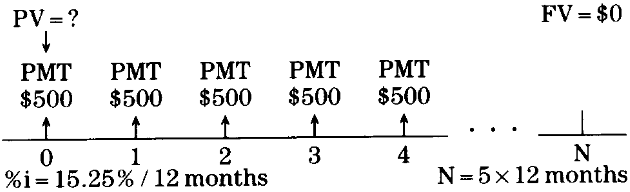
Example

You have been offered an investment paying $500 monthly for five years. You want to get a return of 15.25% compounded monthly on your investment. How much is this investment worth with (a) end-of-month payments or (b) beginning-of-month payments?

For end-of-month payments:



For beginning-of-month payments:



Example (Continued)

Procedure	Press	Display
Clear calculator and mode registers; select two decimal places.	[CE/C] [CE/C] [2nd] [CMR] [2nd] [Fix] 2	0.00
Press [MODE] until **FIN** is displayed.	[MODE]	0.00
Press [2nd] [BGN] until **Begin** is **not** displayed.	[2nd] [BGN]	0.00
Enter amount of payment.	500 [PMT]	500.00
Enter number of payments.	5 [×] 12 [=] [N]	60.00
Enter monthly interest rate.	15.25 [÷] 12 [=] [%i]	1.27
Calculate present value of end-of-month payments.	[CPT] [PV]	20,901.82
Press [2nd] [BGN] (**Begin** is displayed).	[2nd] [BGN]	20,901.82
Calculate present value of beginning-of-month payments.	[CPT] [PV]	21,167.45

Special Functions for Monthly Compounding or Payment Periods

Your calculator has two functions that are useful with problems that involve monthly compounding or payment periods. These functions save keystrokes when entering data, allowing you to concentrate on analyzing the problem and the results.

[2nd] [÷12] Monthly Interest Key Sequence

The [2nd] [÷12] key sequence divides the number in the display by 12 and displays the result. This number can then be stored as the monthly interest rate (%i).

To use the [2nd] [÷12] key sequence:

1. Enter the annual interest rate for a compound interest or annuity problem.
2. Press [2nd] [÷12].

You can then press [%i] to store the result.

This key sequence saves you a keystroke, thus minimizing errors. The two steps above have the same effect as entering the annual interest rate and then pressing [÷] 12 [=].

[2nd] [×12] Monthly Payment Key Sequence

The [2nd] [×12] key sequence multiplies the number in the display by 12 and displays the result. This number can then be stored as the number of compounding periods or payment periods (N).

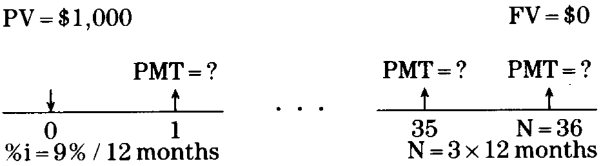
To use the [2nd] [×12] key sequence:

1. Enter the number of years for a compound interest or annuity problem with monthly compounding or payment periods.
2. Press [2nd] [×12].

You can then press [N] to store the result.

This key sequence saves you a keystroke, thus minimizing errors. The two steps above have the same effect as entering the number of years and then pressing [×] 12 [=].

Example If you loan a friend $1,000 for three years at 9% annual interest compounded monthly, how much should the payments be?



Procedure	Press	Display
Clear calculator and mode registers; select two decimal places.	CE/C CE/C 2nd [CMR] 2nd [Fix] 2	0.00
Press MODE until **FIN** is displayed.	MODE	0.00
Press 2nd [BGN] until **Begin** is **not** displayed.	2nd [BGN]	0.00
Calculate and enter total number of payments.	3 2nd [×12] N	36.00
Enter loan amount.	1000 PV	1,000.00
Calculate and enter monthly interest rate.	9 2nd [÷12] %i	0.75
Calculate payment.	CPT PMT	31.80

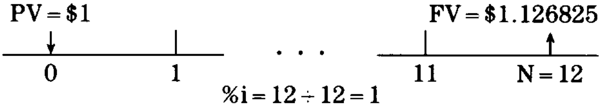
Comparing Annual Interest Rates

You may need to compare interest rates on investments that have the same annual percentage rate (APR) but a different number of compounding periods per year. In these situations, simply comparing the APRs is misleading. Before you can make a valid comparison, you need to convert the APR to the annual effective interest rate (EFF) for each investment.

Annual Percentage Rate (APR)

Annual interest rates are often specified as annual percentage rates (APR) or annual nominal rates. The annual rate is the interest rate per compounding period multiplied by the number of compounding periods per year.

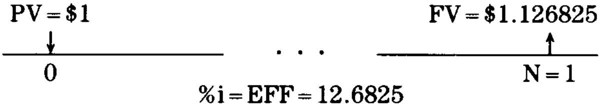
For example, an investment with a 1% monthly compounding rate has an annual percentage rate (APR) of 12%. If you invest $1 at an APR of 12% compounded monthly, the value of the investment after one year is $1.126825.



Annual Effective Rate (EFF)

The annual effective rate (EFF) is the interest rate compounded yearly that achieves the same future value as the APR. EFF is the rate at which you actually earn for the period of time stated.

With an APR of 12% compounded monthly, an investment of $1 is worth $1.126825 at the end of one year. The annual effective rate is the interest rate compounded yearly that achieves the same result. Using the compound interest keys on your calculator, you can find that this interest rate is 12.6825%.



In other words, a 12% APR compounded monthly is equivalent to a 12.6825% annual effective rate.

By using the 2nd [►EFF] and 2nd [►APR] key sequences on your calculator, you can convert both annual percentage rates and annual effective rates quickly and easily. Examples are shown on the following pages.

Converting to EFF or APR

To convert to EFF or APR, you need to know the rate from which you are converting and the number of compounding periods per year (c/yr) for the APR.

2nd [►EFF] APR to EFF Conversion Key Sequence

The 2nd [►EFF] key sequence converts annual percentage rates to annual effective rates.

To convert an APR to an EFF:

1. Enter the APR.
2. Press 2nd [►EFF].
3. Enter the number of compounding periods per year (c/yr) for the APR.
4. Press = to calculate the EFF.

2nd [►APR] EFF to APR Conversion Key Sequence

The 2nd [►APR] key sequence converts annual effective rates to annual percentage rates.

To convert an EFF to an APR:

1. Enter the EFF.
2. Press 2nd [►APR].
3. Enter the number of compounding periods per year (c/yr) for the APR.
4. Press = to calculate the APR.

(continued)

Converting an APR to an EFF

A bank is offering a certificate that pays an APR of 15% with monthly compounding. What is the annual effective rate?

When you use the 2nd [▸EFF] key sequence to convert an annual percentage rate to an annual effective rate, the calculator automatically uses the following equation to perform the calculation. (c/yr is the number of compounding periods per year.)

$$EFF = \left[\left[1 + \frac{\%APR}{100 \times (c/yr)} \right]^{c/yr} - 1 \right] \times 100$$

Procedure	Press	Display
Clear calculator and select two decimal places.	CE/C CE/C 2nd [Fix] 2	0.00
Enter APR.	15	15
Calculate annual effective rate for 12 compounding periods per year.	2nd [▸EFF] 12 =	16.08

An APR of 15% compounded monthly is equivalent to an annual effective rate of 16.08%.

Converting an EFF to an APR

You are considering an investment that earns an annual effective rate of 18%. What is the equivalent APR with weekly compounding?

When you use the 2nd [►APR] key sequence to convert an annual effective rate to an annual percentage rate, the calculator automatically uses the following equation to perform the calculation. (c/yr is the number of compounding periods per year.)

$$APR = [(1 + \%EFF/100)^{1/(c/yr)} - 1] \times (c/yr) \times (100)$$

Procedure	Press	Display
Clear calculator and select two decimal places.	CE/C CE/C 2nd [Fix] 2	0.00
Enter annual effective rate.	18	18
Calculate the APR for 52 compounding periods per year.	2nd [►APR] 52 =	16.58

An annual effective rate of 18% is equivalent to an APR of 16.58% compounded weekly.

Calculating Balance, Interest, and Principal

The functions presented in this section are especially for amortization of annuities, such as loans or leases. The keys can be used only in the financial mode and can be used only after interest rate, payment amount, present value, and number of payment periods have been entered.

BAL
Balance Key

The BAL key calculates the remaining loan balance (principal) after a selected payment.

To find the balance:

1. If necessary, press 2nd [BGN] to change the calculator to solve for end-of-period payments or beginning-of-period payments.
2. Enter the appropriate values with the N, %I, PV, FV, and PMT keys.
3. Enter the payment number.
4. Press BAL.

I/P
Interest and Principal Key

The I/P key calculates the interest and principal portions of a **single** payment. When used with the P1/P2 key, it calculates the accumulated interest and principal over a **range** of payments (see page 3–19).

To find the interest and principal of a single payment:

1. If necessary, press 2nd [BGN] to change the calculator to solve for end-of-period payments or beginning-of-period payments.
2. Enter the appropriate values with the N, %I, PV, FV, and PMT keys.
3. Enter the payment number.
4. Press I/P to calculate the interest.

   The **int** indicator is displayed with the result.
5. Press the x⇆y key to display the principal.

   The **prn** indicator is displayed with the result.

P1/P2
Payment Range Entry Key

The P1/P2 key, in conjunction with the I/P key, enables you to calculate the summed interest and principal over a **range** of payments. P1/P2 enters a selected range of payments (Payment 1 through Payment 2).

To find the summed interest and principal over a range of payments:

1. If necessary, press 2nd [BGN] to change the calculator to solve for end-of-period payments or beginning-of-period payments.

2. Enter the appropriate values with the N, %I, PV, FV, and PMT keys.

3. Enter the first payment number (P1) and press P1/P2.

4. Enter the second payment number.

5. Press I/P to calculate the interest.

   The Σint indicator is displayed with the result.

6. Press the x⇆y key to display the principal.

   The Σprn indicator is displayed with the result.

If you want to display the interest portion again, you can press x⇆y. Pressing x⇆y alternately displays the interest and principal.

Note: Both the first and second payment numbers entered in steps 3 and 4 above must be integers (no fractional part). Entering a payment number with a fractional part will cause incorrect results.

(continued)

Example

You have made 16 payments on your home mortgage. The mortgage amount was $68,499.57 for 30 years, and the annual interest rate is 13.25% compounded monthly. The monthly payment is $771.15 (not including taxes and insurance).

You have three questions: (A) What is your current loan balance? (B) What are the interest and principal portions of payment 16? (C) What is the summed interest and principal of payments 5 through 16?

Procedure	Press	Display
Clear calculator and mode registers; select two decimal places.	CE/C CE/C 2nd [CMR] 2nd [Fix] 2	0.00
Press MODE until **FIN** is displayed.	MODE	0.00
Press 2nd [BGN] until **Begin** is **not** displayed.	2nd [BGN]	0.00
Enter mortgage amount.	68499.57 PV	68,499.57
Calculate and enter monthly interest rate.	13.25 2nd [÷12] %i	1.10
Calculate and enter total number of payments.	30 2nd [×12] N	360.00
Enter payment amount.	771.15 PMT	771.15

	Procedure	Press	Display
Part A: Loan Balance	Enter payment number and calculate balance.	16 BAL	68,242.10
Part B: Interest and Principal on a Single Payment	Enter payment number and calculate interest.	16 I/P	753.70
	Display principal.	x⇄y	17.45
Part C: Interest and Principal over a Range of Payments	Enter first payment number.	5 P_1/P_2	5.00
	Enter second payment number and calculate summed interest.	16 I/P	9,056.52
	Display principal.	x⇄y	197.28

Chapter 4: Statistics Functions

In many situations in business and everyday life, you may find yourself handling a set of data points that can best be analyzed with statistical techniques. This chapter discusses the keys that enable you to perform statistical calculations.

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Entering and Removing Data Points

Before you can perform statistical calculations, you must place the calculator in the statistics mode by using the MODE key. You can then enter data points with either one or two variables.

2nd [CMR] Clear Mode Registers Key Sequence

The 2nd [CMR] key sequence clears any previously entered data points. You should always use this key sequence to clear the mode registers before you attempt to enter a new set of statistical data points.

Σ+ Data Entry Key

The Σ+ key enables you to enter either one- or two-variable data points. Each time you press Σ+ to enter a value, the calculator displays the total number of data points stored in the statistical registers.

Entering One-Variable Data Values

To enter a data point with one variable:

1. Enter the value.
2. Press Σ+.

Repeat the procedure to enter additional data points.

Entering Two-Variable Data Values

To enter a data point with two variables (x,y):

1. Enter the x value and press x⇆y.
2. Enter the y value and press Σ+.

Repeat the procedure to enter additional data points.

2nd [Σ−] Data Removal Key Sequence

The 2nd [Σ−] key sequence enables you to remove any data points that you have previously entered. You can remove either one- or two-variable data points. Each time you press 2nd [Σ−] to remove a value, the calculator displays the total number of data points stored in the statistical registers.

Removing One-Variable Data Points

To remove a data point with one variable:

1. Enter the value you want to remove.
2. Press 2nd [Σ−].

Repeat this procedure for any additional data points you want to remove.

Removing Two-Variable Data Points

To remove a data point with two variables (x,y):

1. Enter the x value and press x⇆y.
2. Enter the y value and press 2nd [Σ−].

Repeat this procedure for any additional data points you want to remove.

Calculating Mean and Standard Deviation

After entering all the data points, you can calculate their mean or standard deviation. When the display shows mean or standard deviation for the dependent variables (y), Dep appears in the display. When the display shows mean or standard deviation for the independent variables (x), InDep appears in the display.

2nd [Mean]
Data Mean
Key Sequence

The 2nd [Mean] key sequence calculates the mean (average) of the data points.

- For one-variable data points, press 2nd [Mean].
- For two-variable data points:
  1. Press 2nd [Mean] to display the mean of the y values.
  2. Press x⇆y to display the mean of the x values.

2nd [σ_n]
Population
Standard
Deviation
Key Sequence

The 2nd [σ_n] key sequence calculates the population (n weighted) standard deviation. Use this key sequence when data is taken from every member of a population.

- For one-variable data points, press 2nd [σ_n].
- For two-variable data points:
  1. Press 2nd [σ_n] to display the population standard deviation of the y values.
  2. Press x⇆y to display the population standard deviation of the x values.

2nd [σ_{n-1}]
Sample
Standard
Deviation
Key Sequence

The 2nd [σ_{n-1}] key sequence calculates the sample (n – 1 weighted) standard deviation. Use this key sequence when data is taken from a sample of a population.

- For one-variable data points, press 2nd [σ_{n-1}].
- For two-variable data points:
  1. Press 2nd [σ_{n-1}] to display the sample standard deviation of the y values.
  2. Press x⇆y to display the sample standard deviation of the x values.

Example: One-Variable Statistics

This example shows you how to enter and remove one-variable data points and how to perform one-variable calculations.

Example

You randomly select a sample of eight stores to see how much they charge for a particular item. The prices (rounded to the nearest dollar) are shown below.

63, 66, 69, 69, 71, 72, 74, 76

Find the mean and sample standard deviation (σ_{n-1}).

Procedure	Press	Display
Clear calculator and mode registers; select floating-decimal format.	CE/C CE/C 2nd [CMR] 2nd [Fix] ·	0.
Press MODE until **STAT** is displayed.	MODE	0.
Begin entering the data points.	63 Σ+ 66 Σ+	2.
	69 Σ+ 69 Σ+	4.
Enter an incorrect value.	70 Σ+	5.
Remove the incorrect value.	70 2nd [Σ−]	4.
Enter the remaining values.	71 Σ+ 72 Σ+	6.
	74 Σ+ 76 Σ+	8.
Calculate mean.	2nd [Mean]	70.
Calculate sample standard deviation.	2nd [σ_{n-1}]	4.208834246

Example: Two-Variable Statistics

This example shows you how to enter two-variable data points and how to perform two-variable calculations.

Example Enter the following data pairs.

(101.3, 609)	(103.7, 626)	(98.6, 586)
(99.9, 594)	(97.2, 579)	(100.1, 605)

Then calculate the mean and population standard deviation (σ_n).

Procedure	Press	Display
Clear calculator and mode registers; select floating-decimal format.	[CE/C] [CE/C] [2nd] [CMR] [2nd] [FIx] [·]	0.
Press [MODE] until **STAT** is displayed.	[MODE]	0.
Enter the data pairs.	101.3 [x⇆y] 609 [Σ+]	1.
	103.7 [x⇆y] 626 [Σ+]	2.
	98.6 [x⇆y] 586 [Σ+]	3.
	99.9 [x⇆y] 594 [Σ+]	4.
	97.2 [x⇆y] 579 [Σ+]	5.
	100.1 [x⇆y] 605 [Σ+]	6.

Example (Continued)

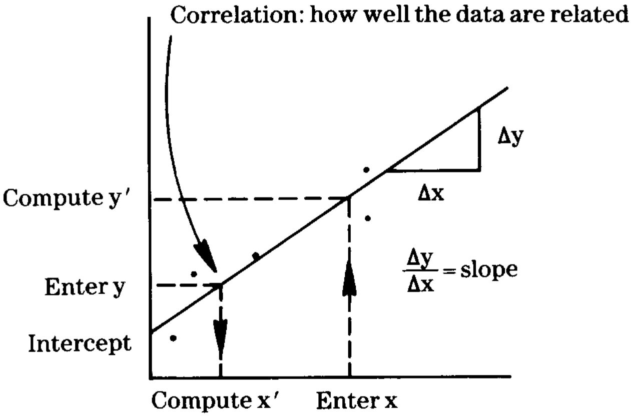
Procedure	Press	Display
Display the mean of the y values.	2nd [Mean]	599.8333333
Display the mean of the x values.	x⇆y	100.1333333
Display the standard deviation of the y values.	2nd [σn]	15.57151959
Display the standard deviation of the x values.	x⇆y	2.04504822

Linear Regression

In many business applications, you may need to find a relationship between two sets of related data values. By labeling the sets x and y, you can apply linear regression to calculate a straight line that best represents the relationship between the two sets. You can then use the equation for this line to predict future events.

The Representative Line

If you plot the x and y data, the linear relationship between the points is graphically illustrated by one line that should ideally contain every point. In actual practice, however, the points may not be perfectly linear. Linear regression enables you to calculate the line that best fits all the data points, with the least amount of error.


Correlation: how well the data are related
Δy
Δx
Compute y′
$\frac{\Delta y}{\Delta x}$ = slope
Enter y
Intercept
Compute x′
Enter x

This line is described by the equation:

$y = ax + b$

where a is the slope of the line
b is the y-intercept

2nd [b/a]
Intercept/Slope
Key Sequence

The 2nd [b/a] key sequence enables you to display the y-intercept and slope of the representative line.

- ► To display the y-intercept (b), press 2nd [b/a].
- ► To display the slope (a), press x⇆y after you display the y-intercept.

2nd [Corr]
Correlation
Key Sequence

The 2nd [Corr] key sequence calculates the correlation coefficient for the entered data. This is a number between – 1 and 1 that indicates how well the calculated line actually represents the data points.

- ► If the value is close to 1, the representative line is a close approximation of the data points. Most of the data points are on or very near the line.
- ► If the value is close to zero, the representative line has little validity.
- ► If the value is close to – 1, the representative line is a close "negative" approximation of the data points. That is, an increase in one is related to a decrease in the other.

(continued)

2nd [x'], 2nd [y'] Predicted Value Key Sequences

The 2nd [x'] and 2nd [y'] key sequences enable you to predict additional x and y values.

- To predict an x value:
  1. Enter the new y value.
  2. Press 2nd [x'] to display the corresponding x value.
- To predict a y value:
  1. Enter the new x value.
  2. Press 2nd [y'] to display the corresponding y value.

Precautions for Predicting Values

In most instances, the x variable is considered the independent variable, while y is the dependent variable. It is not statistically valid to:

- Compute an x value on the basis of a y value.
- Compute a y value on the basis of an x value that is outside the range of entered x values. Even though the correlation coefficient may be close to 1 within that range, you cannot be absolutely certain that data taken outside the range follows the same linear relationship.

However, calculations involving forecasting and trend line analysis often use these computations to make predictions about the future. When you perform such calculations, it is important to remember that the results only indicate what could happen based on the data you entered.

Example

A life insurance company has found that the volume of sales in each office varies according to the number of salespeople. Offices in various cities have the following number of salespeople and resulting sales.

Number of salespeople	7	12	4	5	11	9
Sales in $1000 per month	99	152	81	98	145	112

Perform a linear regression analysis to:

- Predict the amount of sales if the company establishes a new office with 10 salespeople.
- Predict the number of salespeople needed to produce $115,000 in monthly sales.
- Determine the correlation coefficient of the data values and the slope and intercept of the line.

Part A

Tabulate the data in terms of x and y, and enter the values into the statistical registers. Then predict the y value if x is 10.

x	y
7	99000
12	152000
4	81000
5	98000
11	145000
9	112000

(continued)

Part A
(Continued)

Procedure	Press	Display
Clear calculator and mode registers; select two decimal places.	CE/C CE/C 2nd [CMR] 2nd [Fix] 2	0.00
Press MODE until **STAT** is displayed.	MODE	0.00
Enter the data sets.	7 x⇆y 99000 Σ+	1.00
	12 x⇆y 152000 Σ+	2.00
	4 x⇆y 81000 Σ+	3.00
	5 x⇆y 98000 Σ+	4.00
	11 x⇆y 145000 Σ+	5.00
	9 x⇆y 112000 Σ+	6.00
Enter x value.	10	10
Predict y′.	2nd [y′]	131,346.15

You can estimate that 10 salespeople will produce $131,346.15 per month.

Note: Do not erase the data from the statistical registers. This data is used in the next part of the example.

Part B

Using the data values previously stored in the calculator, predict the number of salespeople needed to produce $115,000.

Procedure	Press	Display
Enter y value.	115000	115,000
Calculate x′.	2nd [x′]	8.06

To produce $115,000 in monthly sales, you need eight salespeople.

Part C

Calculate the correlation coefficient, the y-intercept, and the slope of the representative line.

Procedure	Press	Display
Calculate correlation coefficient.	2nd [Corr]	0.96
Calculate the y-intercept (b).	2nd [b/a]	47,115.38
Calculate the slope (a).	x⇆y	8,423.08

Because the correlation coefficient is close to 1, the following equation is a good linear approximation of the data values.

y = 8,423.08x + 47,115.38

In the future, you can use this equation to calculate y for any given x without re-entering all the data.

Trend Line Analysis: Predicting Yearly Events

You can also apply a form of linear regression to analyze data that is in the form of yearly figures. This type of linear regression is referred to as "trend line analysis" and is helpful in predicting what will happen in subsequent years.

Example

A stock has reported the following earnings per share from 1981 through 1985.

$1.52 $1.35 $1.53 $2.17 $3.60

Predict the earnings per share for the next three years, and predict the year in which you could expect the earnings per share to reach $6.50.

First tabulate the data in terms of x and y.

x	y
1981	$1.52
1982	$1.35
1983	$1.53
1984	$2.17
1985	$3.60

Then, use the following steps to enter the data.

1. Enter the first x value (1981), and press [x⇆y].
2. Enter the corresponding y value (1.52), and press [Σ+].
3. Enter the rest of the y values, pressing [Σ+] after each value.

Because the x values increase in increments of 1, you only need to enter x for the first data pair. Each time you enter a new y value, the calculator automatically increments the value of x.

Example (Continued)

Procedure	Press	Display
Clear calculator and mode registers; select two decimal places.	CE/C CE/C 2nd [CMR] 2nd [Fix] 2	0.00
Press MODE until STAT is displayed.	MODE	0.00
Enter the first pair of data values.	1981 x⇆y 1.52 Σ+	1.00
Enter remaining y data.	1.35 Σ+ 1.53 Σ+ 2.17 Σ+ 3.6 Σ+	5.00
Project earnings for 1986.	1986 2nd [y']	3.53
Project earnings for 1987.	1987 2nd [y']	4.03
Project earnings for 1988.	1988 2nd [y']	4.52
Find the year for projected earnings of $6.50.	6.5 2nd [x']	1,991.97

The projected earnings for 1986, 1987, and 1988 are $3.53, $4.03, and $4.52, respectively. The projected earnings reach $6.50 in 1992 (the first full year after 1991.97).

Chapter 5: Fundamental Real Estate

This chapter describes a number of current techniques used to finance a home mortgage. This includes some of the newer "creative financing" mortgages such as variable rate mortgages and "buy-down" mortgages.

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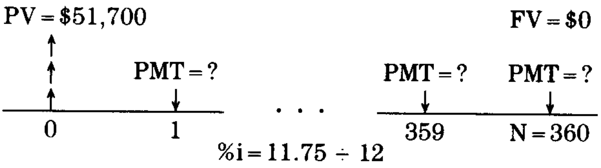
Monthly Payment for a Home with an Ordinary Mortgage

You are buying a $57,500 house. You plan to make a $5,800 down payment and finance the rest at 11.75% annual interest for 30 years. Excluding taxes and insurance, how much is your monthly mortgage payment? If taxes and insurance average 30% of your mortgage payment, how much is your total house payment?

Example The mortgage amount is the price of the house minus the down payment.



Procedure	Press	Display
Clear calculator and mode registers; select two decimal places.	CE/C CE/C 2nd [CMR] 2nd [Fix] 2	0.00
Press MODE until **FIN** is displayed.	MODE	0.00
Press 2nd [BGN] until **Begin** is not displayed.	2nd [BGN]	0.00
Enter monthly interest rate.	11.75 2nd [÷12] %i	0.98
Calculate and enter number of payments.	30 2nd [×12] N	360.00
Calculate and enter mortgage amount.	57500 − 5800 = PV	51,700.00

Example (Continued)

Procedure	Press	Display
Compute monthly payment.	[CPT] [PMT]	521.86
Add estimated taxes and insurance to calculate monthly house payment.	[+] 30 [%] [=]	678.42

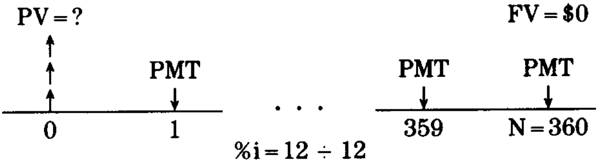
The monthly payment, excluding taxes and insurance, is $521.86. The total payment, including taxes and insurance, is $678.42.

Loan Amount a Buyer Can Afford

Suppose a loan company will finance your house if the total monthly payment does not exceed 25% of your gross income. The total payment includes taxes and insurance, which are 30% of the loan payment. Your gross monthly income is $2,700. If you put 15% down, what price house can you afford at a 12% annual interest rate for 30 years?

Example

The time line for this example is shown below.



Procedure	Press	Display
Clear calculator and mode registers; select two decimal places.	CE/C CE/C 2nd [CMR] 2nd [Fix] 2	0.00
Press MODE until **FIN** is displayed.	MODE	0.00
Press 2nd [BGN] until **Begin** is **not** displayed.	2nd [BGN]	0.00
Enter monthly interest rate.	12 2nd [÷12] %i	1.00
Calculate and enter number of monthly payments.	30 2nd [×12] N	360.00

Example (Continued)

Procedure	Press	Display
Calculate and store amount of maximum payment.	2700 × 25 % = STO	675.00
Calculate and enter maximum allowable loan payment (without taxes or insurance).	1 + 30 % = 2nd [1/x] × RCL [MEM] = PMT	519.23
Compute maximum allowable loan amount.	CPT PV	50,478.75
Calculate house price (including down payment).	1 − 15 % = 2nd [1/x] × RCL PV =	59,386.76
Calculate down payment.	− RCL PV =	8,908.01

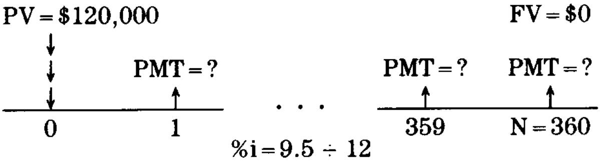
With a down payment of $8,908.01, you can afford to finance a $59,386.76 house.

Determining Points on a Loan

You are loaning Mike $120,000. The monthly payments are based on a 30-year loan, but he will pay off the loan after 10 years. To get a stated annual interest rate of 9.5% compounded monthly, Mike agrees to pay points on the loan. If the market yield rate on mortgages is 10.5% annually with monthly compounding, how many points must he pay?

Example Part A

First, compute the monthly payment amount based on a 30-year mortgage.



Procedure	Press	Display
Clear calculator and mode registers; select two decimal places.	CE/C CE/C 2nd [CMR] 2nd [Fix] 2	0.00
Press MODE until **FIN** is displayed.	MODE	0.00
Press 2nd [BGN] until **Begin** is not displayed.	2nd [BGN]	0.00
Enter stated monthly interest rate.	9.5 2nd [÷12] %i	0.79
Calculate and enter number of payments for amortization.	30 2nd [×12] N	360.00
Enter and store amount borrowed.	120000 PV STO	120,000.00
Compute payment.	CPT PMT	1,009.03

Part B

Using the values entered in Part A, compute the amount required to pay off the loan after 10 years.

Procedure	Press	Display
Calculate and enter number of scheduled payments.	10 2nd [×12] N	120.00
Compute payoff.	CPT FV	108,249.25

Part C

Compute the present value based on an annual nominal yield of 10.5%. Then calculate the points.

Procedure	Press	Display
Enter desired monthly yield.	10.5 2nd [÷12] %I	0.88
Compute present value.	CPT PV	112,832.50
Subtract result from loan amount (stored in Part A) to determine dollar amount of points.	+/− + RCL [MEM] =	7,167.50
Calculate percentage points.	÷ RCL [MEM] × 100 =	5.97

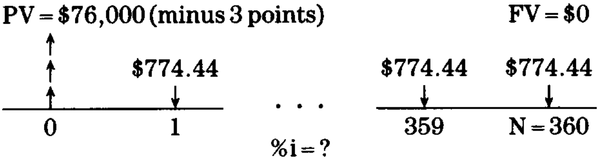
For you to earn an annual yield of 10.5% compounded monthly, Mike must pay 5.97 points.

Actual Interest Rate (Yield) Paid When Buyer Pays Points

Joe borrowed $76,000 for 30 years to purchase a home. His monthly payments of $774.44 are based on an annual interest rate of 11.875% compounded monthly. Joe had to pay three points to borrow the money. What are the annual nominal interest rate (yield), compounded monthly, and the annual effective rate for Joe's mortgage?

Example

Because he paid three points, Joe only received $73,720 (97% of $76,000). However, he must repay the full mortgage amount and pay interest on the full amount.



Procedure	Press	Display
Clear calculator and mode registers; select two decimal places.	CE/C CE/C 2nd [CMR] 2nd [Fix] 2	0.00
Press MODE until **FIN** is displayed.	MODE	0.00
Press 2nd [BGN] until **Begin** is **not** displayed.	2nd [BGN]	0.00
Calculate and enter number of payments.	30 2nd [×12] N	360.00
Enter monthly payment.	774.44 PMT	774.44

Example (Continued)

Procedure	Press	Display
Enter mortgage amount minus points.	76000 [−] 3 [%] [=] [PV]	73,720.00
Calculate yield per period.	[CPT] [%i]	1.02
Calculate annual nominal interest rate (yield).	[2nd] [×12]	12.28
Convert to annual effective rate.	[2nd] [►EFF] 12 [=]	13.00

The annual nominal interest rate is 12.28%, which is equivalent to an annual effective rate of 13%.

Selling Price of a House If Seller Pays Points

You originally paid $60,000 for your house and now you want to sell it for a $25,000 profit. If the lending institution requires you to pay five points (5%), what is the selling price of the house?

Example

Because the points are a percentage of the selling price, which is unknown, you cannot directly calculate the five points as a dollar amount. To solve this example, consider the points as a gross profit margin and use the calculator's business functions.

Procedure	Press	Display
Clear calculator and mode registers; select two decimal places.	CE/C CE/C 2nd [CMR] 2nd [Fix] 2	0.00
Press MODE until no mode indicator is displayed.	MODE	0.00
Add original price and profit to calculate cost before points are added on, and enter.	60000 + 25000 = CST	85,000.00
Enter points as a margin.	5 MAR	5.00
Compute selling price.	CPT SEL	89,473.68

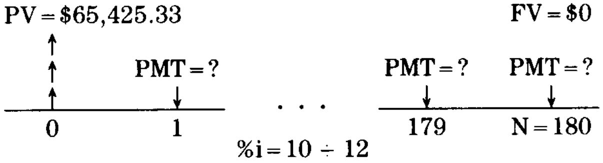
To make a $25,000 profit, you need to sell your house for $89,473.68.

Monthly Payments after Refinancing a Mortgage

You are currently paying $813.69 per month on a mortgage with an annual interest rate of 13.5% compounded monthly. The unpaid balance is $65,425.33. You can refinance the mortgage at a rate of 10% compounded monthly. How much is the monthly payment if you refinance the mortgage for 15 years?

Example

The time line for this example is shown below.



Procedure	Press	Display
Clear calculator and mode registers; select two decimal places.	CE/C CE/C 2nd [CMR] 2nd [Fix] 2	0.00
Press MODE until **FIN** is displayed.	MODE	0.00
Press 2nd [BGN] until **Begin** is **not** displayed.	2nd [BGN]	0.00
Enter monthly interest rate.	10 2nd [÷12] %i	0.83
Calculate and enter number of payments.	15 2nd [×12] N	180.00
Enter amount you want to refinance.	65425.33 PV	65,425.33
Compute amount of new payment.	CPT PMT	703.06

Your new monthly payment would be $703.06.

Accumulated Interest and Principal on a Home Mortgage

You are borrowing $150,000 for 30 years at an annual interest rate of 11% compounded monthly. The end-of-month payments, excluding taxes and insurance, are $1,428.49. The first payment is due at the end of March. How much total interest and principal are you paying in the first two tax years of the mortgage?

Example

First, you need to know the payment numbers included in each tax year.

- The first tax year begins in March and only covers 10 months. Use payment numbers 1 through 10.
- The second tax year covers a full 12 months. Use payment numbers 11 through 22.

You can then compute the accumulated interest and principal over each range of payments.

Procedure	**Press**	**Display**
Clear calculator and mode registers; select two decimal places.	CE/C CE/C 2nd [CMR] 2nd [Fix] 2	0.00
Press MODE until **FIN** is displayed.	MODE	0.00
Press 2nd [BGN] until **Begin** is not displayed.	2nd [BGN]	0.00
Enter monthly interest rate.	11 2nd [÷12] %I	0.92
Calculate and enter number of payments.	30 2nd [×12] N	360.00
Enter mortgage amount.	150000 PV	150,000.00
Enter monthly payment amount.	1428.49 PMT	1,428.49

Example (Continued)

Procedure	Press	Display
Compute total interest for payment numbers 1 through 10.	1 [P1/P2] 10 [I/P]	13,727.39
Display total principal.	[x⇆y]	557.51
Compute total interest for payment numbers 11 through 22.	11 [P1/P2] 22 [I/P]	16,402.11
Display total principal.	[x⇆y]	739.77

In the first tax year, you pay $13,727.39 in interest and $557.51 in principal. In the second tax year, you pay $16,402.11 in interest and $739.77 in principal.

Note: You can also compute the interest and principal portion of each individual payment. To display the interest portion, enter the payment number and press [I/P]. Then press [x⇆y] to display the principal portion.

When using your calculator to find accumulated interest and principal, you may encounter minor differences between the results you obtain and those of your mortgage company or other financial institution.

Monthly Payment on a Mortgage with a Balloon Payment

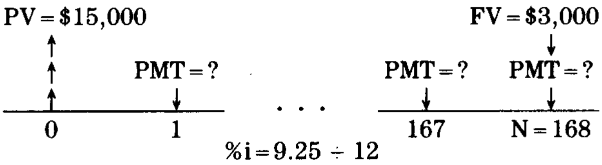
You want to borrow $15,000 to buy a small lake house. In 14 years, you can make a balloon payment of $3,000. The 14-year mortgage (including the balloon payment) has an annual interest rate of 9.25% compounded monthly. What is your monthly payment with and without the balloon payment?

Example

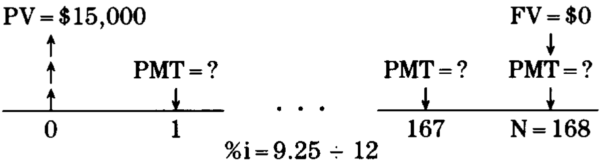
When a mortgage has a balloon payment, you must pay the balloon amount at the end of the series of regular payments. You can also use a balloon payment to pay off a loan before its normal duration is complete.

The balloon amount is due in addition to the last regular payment. The balloon may be larger or smaller than the regular payment. In the following time lines, the balloon payment is shown as FV.

With the balloon payment:



Without the balloon payment:



Example (Continued)

Procedure	Press	Display
Clear calculator and mode registers; select two decimal places.	CE/C CE/C 2nd [CMR] 2nd [Fix] 2	0.00
Press MODE until **FIN** is displayed.	MODE	0.00
Press 2nd [BGN] until **Begin** is **not** displayed.	2nd [BGN]	0.00
Enter monthly interest rate.	9.25 2nd [÷12] %i	0.77
Calculate and enter number of monthly payments.	14 2nd [×12] N	168.00
Enter amount of mortgage.	15000 PV	15,000.00
Enter amount of balloon.	3000 FV	3,000.00
Compute payment with a balloon.	CPT PMT	150.76
Enter zero for future value.	0 FV	0.00
Compute payment without a balloon.	CPT PMT	159.54

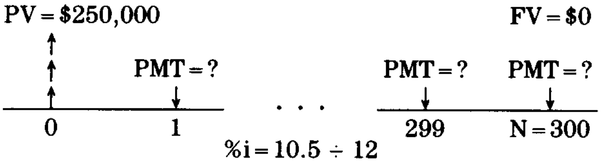
The monthly payment is $150.76 with the $3,000 balloon, and $159.54 without the balloon.

Balloon Payment Needed to Pay Off a Loan

Consider a mortgage balance of $250,000 that terminates in 25 years. The annual interest rate is 10.5% compounded monthly. You want to pay off the loan in 15 years by making a balloon payment. How much is the balloon payment?

Example Part A

First, compute the regular monthly payment based on a 25-year loan, with no balloon payment.



Procedure	Press	Display
Clear calculator and mode registers; select two decimal places.	CE/C CE/C 2nd [CMR] 2nd [Fix] 2	0.00
Press MODE until **FIN** is displayed.	MODE	0.00
Press 2nd [BGN] until **Begin** is **not** displayed.	2nd [BGN]	0.00
Enter monthly interest rate.	10.5 2nd [÷12] %i	0.88
Calculate and enter number of scheduled payments.	25 2nd [×12] N	300.00
Enter amount of mortgage.	250000 PV	250,000.00
Compute monthly payment.	CPT PMT	2,360.45

Part B

Using the regular monthly payment from Part A, compute the amount of the balloon payment. The balloon payment is the balance remaining on the mortgage after 15 years.

Procedure	Press	Display
Enter amount of payment rounded to nearest cent.*	2360.45 [PMT]	2,360.45
Calculate number of payments made after 15 years.	15 [2nd] [×12]	180.00
Compute balloon payment.	[BAL]	174,934.55

In 15 years, you can pay off the loan by making a balloon payment of $174,934.55.

* Although the display in Part A shows the computed payment amount rounded to two decimal places, the calculator uses all internal digits for subsequent calculations. Because payments must be in dollars and cents, you need to re-enter the rounded amount.

Payments on a Variable Rate Mortgage

Using a variable rate mortgage, Ken borrowed $35,000 for 30 years. The mortgage originally had an annual interest rate of 11.5% compounded monthly, and the monthly payment was $346.60. After two years, the annual interest rate increased to 12.5%. How much is the new payment?

Example

Some mortgages now have provisions for changing the interest rate periodically to reflect changes in the cost of money in the market. A new payment amount is calculated and the number of remaining payments remains constant.

To solve this example, enter the values for the original mortgage and:

- Calculate the remaining balance after two years. Enter the result as the new loan amount (present value).
- Enter the number of remaining payments, and enter the new interest rate.

Then compute the new monthly payment amount.

Procedure	Press	Display
Clear calculator and mode registers; select two decimal places.	CE/C CE/C 2nd [CMR] 2nd [Fix] 2	0.00
Press MODE until **FIN** is displayed.	MODE	0.00
Press 2nd [BGN] until **Begin** is not displayed.	2nd [BGN]	0.00
Enter original monthly interest rate.	11.5 2nd [÷12] %i	0.96

Example (Continued)

Procedure	Press	Display
Enter original loan amount.	35000 PV	35,000.00
Enter original payment amount.	346.6 PMT	346.60
Calculate and enter total number of payments.	30 2nd [×12] N	360.00
Calculate number of payments made at original amount.	2 2nd [×12]	24.00
Compute balance and enter as present value.	BAL PV	34,699.83
Calculate and enter number of remaining payments.	360 − 24 = N	336.00
Enter new monthly interest rate.	12.5 2nd [÷12] %I	1.04
Compute new payment.	CPT PMT	372.92

The new monthly payment is $372.92.

Payments on a Simple "Buy-Down" Mortgage

Joe borrowed $50,000 to buy a house. His 30-year mortgage has an annual interest rate of 15.5% compounded monthly. The seller, however, places an amount in escrow that reduces the interest rate to 12.5% for the first three years. What are the monthly payments, and how much should the seller place in escrow assuming a 6% annual rate compounded monthly?

Example

With a "buy-down" mortgage, the seller subsidizes the borrower's mortgage payments by depositing a lump amount in an escrow account that pays interest. The difference between the borrower's monthly payments and the actual monthly payments is taken from the escrow account each month.

The subsidy's time period usually ranges from one to three years. At the end of the subsidy period, the borrower assumes responsibility for the full payment.

Part A

First, compute the monthly payment based on a 15.5% interest rate.

Procedure	Press	Display
Clear calculator and mode registers; select two decimal places.	CE/C CE/C 2nd [CMR] 2nd [Fix] 2	0.00
Press MODE until **FIN** is displayed.	MODE	0.00
Press 2nd [BGN] until **Begin** is **not** displayed.	2nd [BGN]	0.00
Enter **actual** monthly loan rate.	15.5 2nd [÷12] %I	1.29
Calculate and enter total number of payments.	30 2nd [×12] N	360.00
Enter loan amount.	50000 PV	50,000.00
Compute payment and store.	CPT PMT STO	652.26

Part B

Using the values entered in Part A, compute the subsidized monthly payment. Then compute the amount needed for the escrow account.

Procedure	Press	Display
Enter subsidized monthly loan rate.	12.5 2nd [÷12] %i	1.04
Compute subsidized payment.	CPT PMT	533.63
Compute difference in payments and enter monthly subsidy.	+/− + RCL [MEM] = PMT	118.63
Multiply by number of subsidized payments to find total amount.	× 36 =	4,270.66
Enter monthly escrow account interest rate.	6 2nd [÷12] %i	0.50
Enter number of subsidized payments.	36 N	36.00
Compute amount in escrow account.	CPT PV	3,899.47

Joe makes 36 payments of $533.63. His remaining payments are $652.26. The lender deposits $4,270.66 in escrow if no interest is earned, or $3,899.47 if interest is earned at 6% annually.

Payment and Remaining Balance on a Canadian Mortgage

You borrow $60,000 for 20 years at an annual interest rate of 13% compounded semi-annually. How much are the monthly payment and the amount necessary to pay off the mortgage after five years?

Example Part A

Some Canadian mortgages require you to make monthly payments while interest is compounded semi-annually. Also, the mortgages are usually refinanced at the end of a fixed period of time, such as five years.

To begin, convert the semi-annual interest rate to its equivalent monthly interest rate.

Procedure	**Press**	**Display**
Clear calculator and mode registers; select two decimal places.	CE/C CE/C 2nd [CMR] 2nd [Fix] 2	0.00
Press MODE until **FIN** is displayed.	MODE	0.00
Press 2nd [BGN] until **Begin** is **not** displayed.	2nd [BGN]	0.00
Convert 13% rate with semi-annual compounding to an annual effective rate.	13 2nd [►EFF] 2 =	13.42
Convert effective rate to an annual nominal rate with monthly compounding, and enter monthly rate.	2nd [►APR] 12 = 2nd [÷12] %i	1.06

The 13% semi-annual rate is equal to a 12.66% annual rate with monthly compounding.

Part B

Using the values entered in Part A, compute the monthly payment and the balance after five years.

Procedure	Press	Display
Calculate and enter number of monthly payments.	20 [2nd] [×12] [N]	240.00
Enter amount borrowed.	60000 [PV]	60,000.00
Compute monthly payment.	[CPT] [PMT]	688.52
Enter payment to nearest penny.*	688.52 [PMT]	688.52
Calculate number of payments made.	5 [2nd] [×12]	60.00
Compute balance after five years.	[BAL]	55,389.84

The monthly payment is $688.52, and $55,389.84 is required to pay off the mortgage after five years.

* Although the computed payment amount is displayed with two decimal places, the calculator uses all internal digits for subsequent calculations. Because payments must be in dollars and cents, you need to re-enter the rounded amount.

Chapter 6: Real Estate Investment

Real estate presents many types of investment opportunities. The examples in this chapter can help investors who buy and sell mortgages, loan money for wrap-around mortgages, or own income-producing property.

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Home Improvement Loan (Long Term versus Second Mortgage)

You want to buy a $64,500 house and would also like to make some improvements. With 10% down, you can finance the house for 30 years at an annual interest rate of 11.25% compounded monthly. You also need $5,000 for improvements, which you could borrow from another source. The improvement loan would be at 14% annual interest, compounded monthly, for two years.

Example

Using the information given above, compare the following situations.

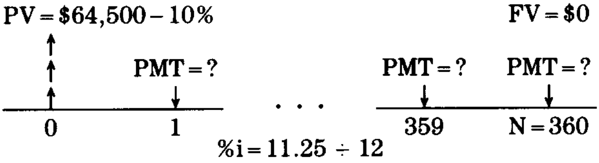
- You could borrow the $5,000 with the separate, two-year improvement loan.
- You could add the $5,000 to the purchase price of the house.

What are the monthly payments for each of these situations?

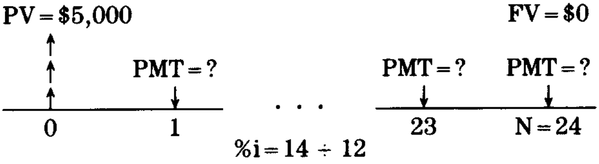
Part A

Calculate the total monthly payment when the home and improvement loans are financed separately.

For the home loan:



For the improvement loan:



Part A (Continued)

Procedure	Press	Display
Clear calculator and mode registers; select two decimal places.	CE/C CE/C 2nd [CMR] 2nd [Fix] 2	0.00
Press MODE until **FIN** is displayed.	MODE	0.00
Press 2nd [BGN] until **Begin** is **not** displayed.	2nd [BGN]	0.00
Enter monthly interest rate for home loan.	11.25 2nd [÷12] %I	0.94
Calculate and enter number of periods in home loan.	30 2nd [×12] N	360.00
Calculate and enter amount of home loan after down payment.	64500 − 10 % = PV	58,050.00
Compute and store payment for home loan.	CPT PMT STO	563.82

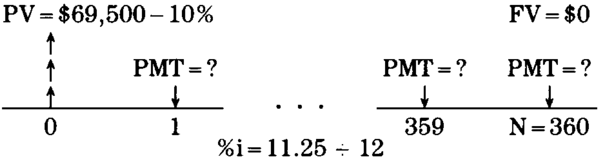
(continued)

Part A (Continued)

Procedure	Press	Display
Calculate and enter number of periods in improvement loan.	2 [2nd] [×12] [N]	24.00
Enter monthly rate on improvement loan.	14 [2nd] [÷12] [%I]	1.17
Enter amount of improvement loan.	5000 [PV]	5,000.00
Compute monthly payment for improvement loan.	[CPT] [PMT]	240.06
Add result to home loan payment to calculate total payment.	[+] [RCL] [MEM] [=]	803.88

Part B

Calculate the total monthly payment for financing both loans for 30 years.



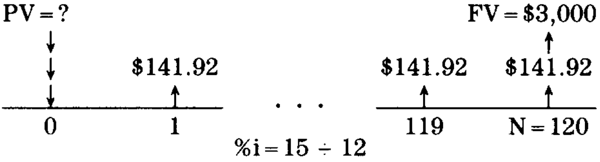
Procedure	Press	Display
Calculate and enter number of payments.	30 $\boxed{\text{2nd}}$ [×12] $\boxed{\text{N}}$	360.00
Enter monthly interest rate.	11.25 $\boxed{\text{2nd}}$ [÷12] $\boxed{\text{\%i}}$	0.94
Calculate total amount for home and improvement loan.	64500 $\boxed{+}$ 5000 $\boxed{=}$	69,500.00
Subtract down payment and enter result.	$\boxed{-}$ 10 $\boxed{\%}$ $\boxed{=}$ $\boxed{\text{PV}}$	62,550.00
Compute total monthly payment.	$\boxed{\text{CPT}}$ $\boxed{\text{PMT}}$	607.52

The combined loan payments would be $803.88 for the first two years. If the improvement loan could be included in the purchase price, the monthly payments would be $607.52 for 30 years.

Price of a Mortgage Necessary to Earn a Specified Yield

You want to buy a mortgage that has 10 years remaining on the term. The end-of-month mortgage payments are $141.92, with a final balloon payment of $3,000. To earn an annual yield of 15% compounded monthly, how much should you pay for the mortgage?

Example The time line for this example is shown below.



Procedure	Press	Display
Clear calculator and mode registers; select two decimal places.	CE/C CE/C 2nd [CMR] 2nd [Fix] 2	0.00
Press MODE until **FIN** is displayed.	MODE	0.00
Press 2nd [BGN] until **Begin** is **not** displayed.	2nd [BGN]	0.00
Enter monthly interest rate.	15 2nd [÷12] %i	1.25
Calculate and enter number of periods.	10 2nd [×12] N	120.00

Example (Continued)

Procedure	Press	Display
Enter monthly payment.	141.92 [PMT]	141.92
Enter amount of balloon payment.	3000 [FV]	3,000.00
Compute present value.	[CPT] [PV]	9,472.25

You should pay about $9,472 for the mortgage.

Yield of a Wrap-Around Mortgage—Equal Number of Payments

Kathy has a 10% mortgage with 180 remaining monthly payments of $746.50. The underlying mortgage has a current balance of $69,467.38. She has applied for a $110,000 wrap-around mortgage with your firm. In this instance, the wrap-around and the underlying mortgage have the same number of payments.

Example

The wrap-around mortgage would have 180 payments of $1,464.92. The annual interest rate is 14% compounded monthly. If your firm makes the loan, compute your:

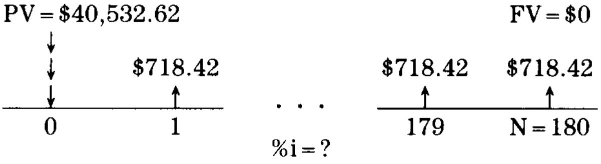
- Annual yield with monthly compounding.
- Annual effective yield.

With a wrap-around mortgage, the lender loans the difference between the amount of the wrap-around mortgage and the balance of the underlying (original) loan. Normally, the lender then makes the payments on the underlying mortgage and receives the payments on the new mortgage from the borrower.

To begin, calculate the net cash flows.

	Wrap-Around Mortgage		Underlying Mortgage		Net Cash Flow
Net loan amount	$110,000.00	–	$69,467.38	=	$40,532.62
Net payment	1,464.92	–	746.50	=	718.42

The time line for this example is shown below.



Example (Continued)

Procedure	Press	Display
Clear calculator and mode registers; select two decimal places.	CE/C CE/C 2nd [CMR] 2nd [Fix] 2	0.00
Press MODE until **FIN** is displayed.	MODE	0.00
Press 2nd [BGN] until **Begin** is **not** displayed.	2nd [BGN]	0.00
Enter number of payments.	180 N	180.00
Subtract old loan balance from wrap loan amount and enter.	110000 − 69467.38 = PV	40,532.62
Subtract old loan payment from wrap payment and enter.	1464.92 − 746.5 = PMT	718.42
Compute annual yield with monthly compounding.	CPT %i 2nd [×12]	20.22
Convert to annual effective yield.	2nd [►EFF] 12 =	22.20

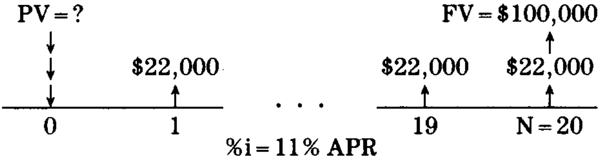
The annual nominal yield with monthly compounding is 20.22%. This is equivalent to an annual effective rate of 22.20%.

Present Value of Income-Producing Property

A piece of property has 20 years remaining on a $22,000 per year lease, with payments made at the end of each year. The reversion value (FV) is forecast to be $100,000. The applicable discount rate is 11% compounded annually. What should you expect to pay for the property today to meet the reversion value and discount rate?

Example

This is a method used by appraisers when they forecast a constant income stream (ordinary annuity) and a reversion value (the value of the property at the end of the time period).



Procedure	**Press**	**Display**
Clear calculator and mode registers; select two decimal places.	CE/C CE/C 2nd [CMR] 2nd [Fix] 2	0.00
Press MODE until **FIN** is displayed.	MODE	0.00
Press 2nd [BGN] until **Begin** is **not** displayed.	2nd [BGN]	0.00
Enter annual discount rate.	11 %i	11.00
Enter number of remaining payments.	20 N	20.00

Example (Continued)

Procedure	Press	Display
Enter annual payment.	22000 [PMT]	22,000.00
Enter reversion value.	100000 [FV]	100,000.00
Compute present value of property.	[CPT] [PV]	187,596.61

You should expect to pay $187,596.61 for the land.

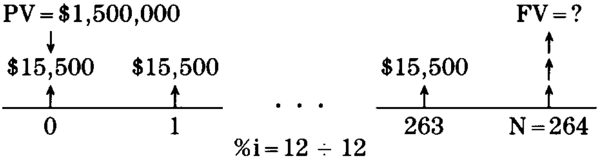
Reversion Value for a Specified Yield

A lease that expires in 22 years requires a $15,500 monthly rental, payable at the beginning of the month. As holder of this lease, you are negotiating with a client who is offering $1,500,000 for the property holding. If the client wants an annual yield of 12% compounded monthly, what reversion value is necessary at the end of the lease period?

Example

In this instance, the reversion value of the property is the difference between the future value of the monthly rentals and the future value of the offered sales price.

You can compute the reversion value (FV) by using the following time line.



Procedure	Press	Display
Clear calculator and mode registers; select two decimal places.	CE/C CE/C 2nd [CMR] 2nd [Fix] 2	0.00
Press MODE until **FIN** is displayed.	MODE	0.00
Press 2nd [BGN] until **Begin** is displayed.	2nd [BGN]	0.00
Enter desired yield.	12 2nd [÷12] %i	1.00
Calculate and enter number of payments.	22 2nd [×12] N	264.00

Example (Continued)

Procedure	Press	Display
Enter rental payment.	15500 [PMT]	15,500.00
Enter sales price.	1500000 [PV]	1,500,000.00
Compute reversion value.	[CPT] [FV]	659,592.24

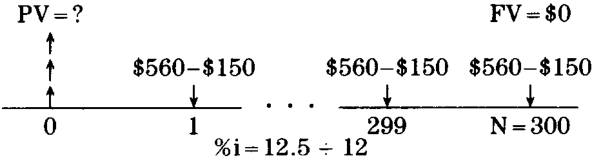
The reversion value must be at least $659,592.24 for the client to receive a 12% return.

Buying Rental Property—Basic Example

Assume that a house rents for $560 a month. You estimate that taxes, insurance, and maintenance will run $150 each month. You can get a 25-year loan for the full cost of the house at an annual interest rate of 12.5% compounded monthly. What is the most you should pay for the house?

Example

Assume that you will buy the property only if the rental income covers the taxes, maintenance, insurance, and loan payment.



Procedure	Press	Display
Clear calculator and mode registers; select two decimal places.	CE/C CE/C 2nd [CMR] 2nd [Fix] 2	0.00
Press MODE until **FIN** is displayed.	MODE	0.00
Press 2nd [BGN] until **Begin** is **not** displayed.	2nd [BGN]	0.00
Enter monthly interest rate.	12.5 2nd [÷12] %i	1.04
Calculate and enter number of payments.	25 2nd [×12] N	300.00
Calculate amount of rent applicable to loan payment.	560 − 150 = PMT	410.00
Compute loan amount.	CPT PV	37,602.46

You should not pay more than $37,602.46 for the house.

Capitalization Rates and Rates of Return

You paid $300,000 for a small office building. You have a 30-year, 9.5% monthly mortgage for $240,000. This income-producing property yields a yearly net operating income of $30,000, which should continue another 10 years. You expect to sell the property in 10 years for 80% of its original purchase price.

Example

Using the information given above, calculate:

1. Overall capitalization rate =

   $$\frac{\text{net operating income}}{\text{total property investment}}$$

2. Cash throw-off (before taxes) =

   net operating income – annual debt service

3. Equity dividend rate (before taxes) =

   $$\frac{\text{cash throw-off}}{\text{equity investment}}$$

   where equity investment = property value – mortgage

4. Capital recovery amount per year for 10 years =

   $$\frac{\text{purchase price} - \text{selling price}}{\text{number of years}}$$

(continued)

Example (Continued)

Procedure	Press	Display
Clear calculator and mode registers; select two decimal places.	CE/C CE/C 2nd [CMR] 2nd [Fix] 2	0.00
Press MODE until **FIN** is displayed.	MODE	0.00
Press 2nd [BGN] until **Begin** is **not** displayed.	2nd [BGN]	0.00
Calculate **overall capitalization rate.**	30000 ÷ 300000 =	0.10
Calculate and enter number of periods.	30 2nd [×12] N	360.00
Enter monthly interest rate.	9.5 2nd [÷12] %I	0.79
Enter mortgage amount as present value.	240000 PV	240,000.00
Compute monthly payment.	CPT PMT	2,018.05
Calculate annual debt service.	2nd [×12]	24,216.60
Calculate and store annual **cash throw-off.**	+/− + 30000 = STO	5,783.40

Example (Continued)

Procedure	Press	Display
Calculate equity investment.	300000 [−] 240000 [=]	60,000.00
Find reciprocal and multiply by cash throw-off to calculate **equity dividend rate**.	[2nd] [1/x] [×] [RCL] [MEM] [=]	0.10
Calculate capital to be recovered.	300000 [−] 80 [%] [=]	60,000.00
Divide by number of years to calculate **capital recovery amount per year** on a straight line basis.	[÷] 10 [=]	6,000.00

The overall capitalization rate is 10%, the cash throw-off is $5,783.40, the equity dividend rate is 10%, and the capital recovery amount is $6,000 per year.

Indicated Overall Capitalization Rate Using Mortgage Constant

The predicted net income stream of an office complex is a level $35,000 annually. You can obtain a 75% mortgage at 10.25% for a term of 25 years, payable monthly. Assuming an annual equity yield rate of 13%, what is the present value of the office complex?

Example

One method used to solve this type of example is to:

1. Compute the annual mortgage constant as shown in the following keystroke solution.
2. Calculate the indicated overall capitalization rate by using the formula:

   (mortgage constant × proportion of mortgage) +
   (proportion of equity × desired equity yield)

3. Calculate the present value by using the formula:

   $$\frac{\text{net operating income}}{\text{overall rate}}$$

Procedure	Press	Display
Clear calculator and mode registers; select two decimal places.	CE/C CE/C 2nd [CMR] 2nd [Fix] 2	0.00
Press MODE until **FIN** is displayed.	MODE	0.00
Press 2nd [BGN] until **Begin** is **not** displayed.	2nd [BGN]	0.00
Enter monthly interest rate.	10.25 2nd [÷12] %i	0.85

Example (Continued)

Procedure	Press	Display
Calculate and enter number of periods.	25 2nd [×12] N	300.00
Enter 1 as present value.	1 PV	1.00
Compute periodic mortgage constant.	CPT PMT	0.01
Find annual mortgage constant.	2nd [×12]	0.11
Multiply by proportion of mortgage, and store.	× 75 % = STO	0.08
Multiply proportion of equity by equity yield rate, and calculate the indicated overall rate.	25 % × 13 % + RCL [MEM] =	0.12
Find reciprocal and multiply by annual income to find present value.	2nd [1/x] × 35000 =	302,050.94

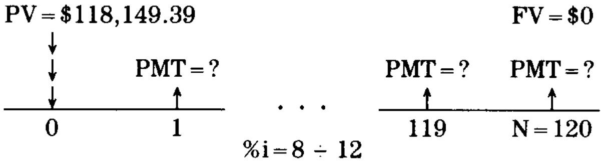
These calculations indicate that the property is worth no more than $302,051, assuming a 13% equity yield rate.

Price of a Discounted Mortgage

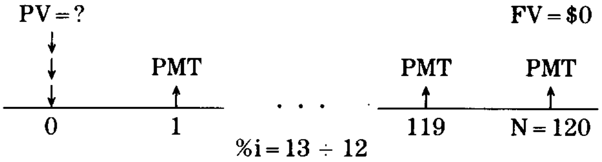
You want to purchase an 8% mortgage that has 10 remaining years. The remaining balance is $118,149.39. If your desired yield is 13%, how much should you pay for the mortgage?

Example

First, compute the monthly payment amount necessary to pay off the remaining balance in 10 years.



Then, using the payment computed above and a desired yield of 13%, compute the purchase price of the mortgage.



Procedure	**Press**	**Display**
Clear calculator and mode registers; select two decimal places.	CE/C CE/C 2nd [CMR] 2nd [Fix] 2	0.00
Press MODE until **FIN** is displayed.	MODE	0.00
Press 2nd [BGN] until **Begin** is **not** displayed.	2nd [BGN]	0.00
Enter monthly interest rate.	8 2nd [÷12] %i	0.67

Example (Continued)

Procedure	Press	Display
Calculate and enter number of mortgage payments.	10 [2nd] [×12] [N]	120.00
Enter remaining balance as present value.	118149.39 [PV]	118,149.39
Compute monthly mortgage payment.	[CPT] [PMT]	1,433.48
Enter desired yield.	13 [2nd] [÷12] [%i]	1.08
Compute price.	[CPT] [PV]	96,006.36

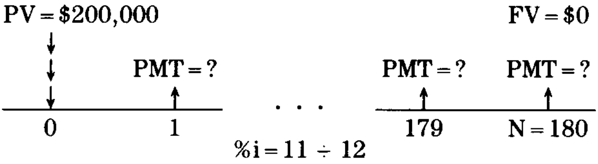
To earn 13%, you should pay about $96,000 for the mortgage.

Yield of a Discounted Mortgage

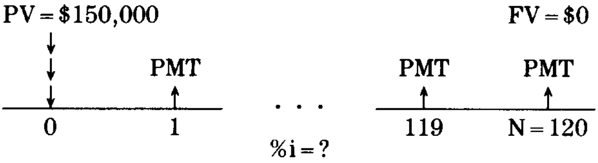
You want to purchase a $200,000 mortgage that has a 15-year term and an annual interest rate of 11% compounded monthly. The mortgage was taken out five years ago, so there are 10 years remaining. If you pay $150,000 for the mortgage, what is the annual yield?

Example

First, compute the monthly mortgage payment.



Then, using the payment computed above and a purchase price of $150,000, compute the annual yield for the remaining 10 years.



Procedure	Press	Display
Clear calculator and mode registers; select two decimal places.	CE/C CE/C 2nd [CMR] 2nd [Fix] 2	0.00
Press MODE until **FIN** is displayed.	MODE	0.00
Press 2nd [BGN] until **Begin** is **not** displayed.	2nd [BGN]	0.00
Enter monthly interest rate.	11 2nd [÷12] %i	0.92

Example (Continued)

Procedure	Press	Display
Calculate and enter total number of mortgage payments.	15 2nd [×12] N	180.00
Enter mortgage amount.	200000 PV	200,000.00
Compute monthly mortgage payment.	CPT PMT	2,273.19
Calculate and enter number of remaining payments.	10 2nd [×12] N	120.00
Enter purchase price.	150000 PV	150,000.00
Compute monthly yield.	CPT %i	1.11
Calculate annual yield.	2nd [×12]	13.38

If you pay $150,000 for the mortgage, your annual yield is 13.38%.

Chapter 7: Savings

Banks and savings institutions may compound interest quarterly, weekly, daily, or continuously. This chapter describes how you can evaluate various interest rates and compounding methods. When you solve a savings problem, be sure to enter the amount of the regular deposits (PMT) as a negative number.

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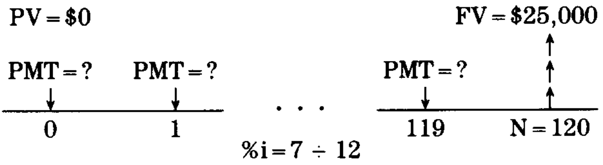
Regular Deposits Necessary for a Specified Future Amount

You plan to open a savings account and deposit the same amount of money at the beginning of each month. In 10 years, you want to have $25,000 in the account. How much should you deposit if the annual interest rate is 7% with (a) monthly compounding, (b) quarterly compounding, (c) daily compounding, or (d) continuous compounding?

Example Part A

If the annual rate is compounded monthly, the number of compounding periods per year equals the number of deposits per year.



Procedure	Press	Display
Clear calculator and mode registers; select two decimal places.	CE/C CE/C 2nd [CMR] 2nd [Fix] 2	0.00
Press MODE until **FIN** is displayed.	MODE	0.00
Press 2nd [BGN] until **Begin** is displayed.	2nd [BGN]	0.00
Enter monthly interest rate.	7 2nd [÷12] %i	0.58
Calculate and enter total number of deposits.	10 2nd [×12] N	120.00
Enter future value.	25000 FV	25,000.00
Compute deposit amount.	CPT PMT	– 143.60

With monthly compounding, you need to make deposits of $143.60.

Part B

If the annual rate is compounded quarterly, the number of compounding periods per year is different than the number of deposits per year. To solve this type of problem, find an equivalent rate that has the same number of compounding periods as the number of payments per year.

For monthly payments and quarterly compounding, convert the annual rate to an equivalent APR with monthly compounding.

Procedure	Press	Display
Convert 7% APR with quarterly compounding to an annual effective rate.	7 [2nd] [►EFF] 4 [=]	7.19
Convert result to APR with monthly compounding, and enter.	[2nd] [►APR] 12 [=] [2nd] [÷12] [%i]	0.58
Compute deposit with quarterly compounding.	[CPT] [PMT]	– 143.92

With quarterly compounding, you need to make deposits of $143.92.

(continued)

Part C

If the annual rate is compounded daily (using a 365-day year), convert the annual rate to an equivalent APR with monthly compounding.

Procedure	Press	Display
Convert 7% APR with daily compounding to an annual effective rate.	7 2nd [►EFF] 365 =	7.25
Convert result to APR with monthly compounding, and enter.	2nd [►APR] 12 = 2nd [÷12] %i	0.58
Compute deposit with daily compounding.	CPT PMT	– 143.44

With daily compounding, you need to make deposits of $143.44.

Part D

If the annual rate is compounded continuously, convert it to an equivalent discrete rate. (The formula used to calculate the discrete rate is given in Appendix A.)

Note: The formula in Appendix A calculates the discrete rate per month.

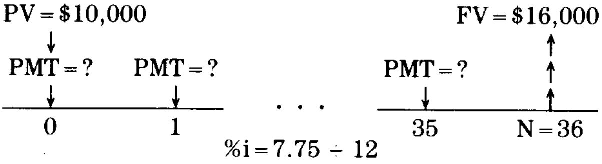
Procedure	Press	Display
Calculate the continuous rate per deposit period.	7 2nd [÷12]	0.58
Convert continuous rate per month to equivalent discrete rate per month, and enter.	% 2nd [eˣ] − 1 × 100 = %I	0.59
Compute deposit with continuous compounding.	CPT PMT	− 143.44

With continuous compounding, you need to make deposits of $143.44.

Payment Amount for an Account with a Beginning Balance

Your savings account balance is $10,000 at the beginning of the month. You want to have $16,000 at the end of three years. If the annual interest rate is 7.75% compounded monthly, how much should you deposit at the beginning of each month?

Example The time line for this example is:



Procedure	Press	Display
Clear calculator and mode registers; select two decimal places.	CE/C CE/C 2nd [CMR] 2nd [Fix] 2	0.00
Press MODE until **FIN** is displayed.	MODE	0.00
Press 2nd [BGN] until **Begin** is displayed.	2nd [BGN]	0.00
Enter monthly interest rate.	7.75 2nd [÷12] %i	0.65
Calculate and enter number of monthly deposits.	3 2nd [×12] N	36.00
Enter beginning balance.	10000 PV	10,000.00
Enter future value.	16000 FV	16,000.00
Compute regular deposit amount.	CPT PMT	−83.45

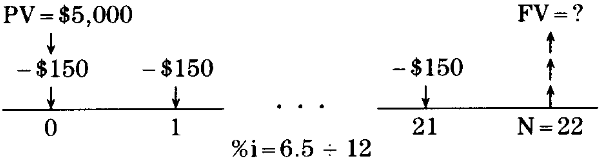
You need to make deposits of $83.45.

Future Value of a Savings Account

You currently have $5,000 in a savings account that earns 6.5% APR, compounded monthly. You plan to start depositing $150 at the beginning of each month. How much money will you have in the account at the end of 22 months?

Example

The time line for this example is:



Procedure	Press	Display
Clear calculator and mode registers; select two decimal places.	CE/C CE/C 2nd [CMR] 2nd [Fix] 2	0.00
Press MODE until **FIN** is displayed.	MODE	0.00
Press 2nd [BGN] until **Begin** is displayed.	2nd [BGN]	0.00
Enter monthly interest rate.	6.5 2nd [÷12] %i	0.54
Enter number of regular deposits.	22 N	22.00
Enter beginning balance.	5000 PV	5,000.00
Enter deposit as a negative value.	150 +/– PMT	– 150.00
Compute future value.	CPT FV	9,144.55

After 22 months, you will have $9,144.55.

Future Value When Compounding and Payment Periods Are Not Equal

You plan to deposit $1,500 at the beginning of each quarter for three years. The savings account pays an annual interest rate of 6% compounded monthly. How much is in the account after three years?

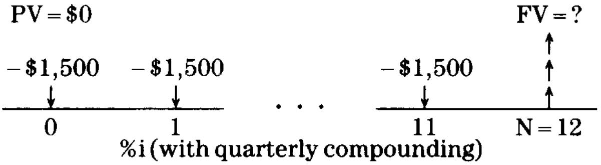
Example

In many instances, the number of payments or deposits per year may differ from the number of compounding periods per year. To solve this problem, you need to find an equivalent interest rate that has the same number of compounding periods as the number of payments per year.

For quarterly deposits and monthly compounding:

1. Convert the APR with monthly compounding to an annual effective rate.
2. Convert the result to an APR with quarterly compounding.

Then, use the APR with quarterly compounding to compute the future value.



Example (Continued)

Procedure	Press	Display
Clear calculator and mode registers; select two decimal places.	CE/C CE/C 2nd [CMR] 2nd [Fix] 2	0.00
Press MODE until **FIN** is displayed.	MODE	0.00
Press 2nd [BGN] until **Begin** is displayed.	2nd [BGN]	0.00
Convert 6% APR with monthly compounding to an EFF.	6 2nd [►EFF] 12 =	6.17
Convert result to APR with quarterly compounding.	2nd [►APR] 4 =	6.03
Calculate and enter rate per deposit period.	÷ 4 = %i	1.51
Calculate and enter number of deposits.	3 × 4 = N	12.00
Enter deposit amount as a negative number.	1500 +/- PMT	– 1,500.00
Compute future value.	CPT FV	19,865.06

You will have $19,865.06 after three years.

Chapter 8: Loans

The amount of interest you pay on a loan depends on the percentage rate of interest, the length of time you borrow the money, and the way the interest is calculated. This chapter can help you evaluate various loan situations.

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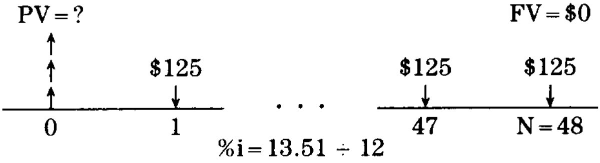
Amount to Borrow and Amount of Down Payment

You want to buy a car that sells for $5,100. The finance company charges 13.51% APR, compounded monthly, on a 48-month loan. If you can afford a monthly payment of $125, how much can you borrow? How much do you need for the down payment?

Example

Calculate the loan amount. Then subtract it from the cost of the car to find the down payment.



Procedure	**Press**	**Display**
Clear calculator and mode registers; select two decimal places.	CE/C CE/C 2nd [CMR] 2nd [Fix] 2	0.00
Press MODE until **FIN** is displayed.	MODE	0.00
Press 2nd [BGN] until **Begin** is **not** displayed.	2nd [BGN]	0.00
Enter number of monthly payments.	48 N	48.00
Enter monthly interest rate.	13.51 2nd [÷12] %i	1.13
Enter payment.	125 PMT	125.00
Compute loan amount.	CPT PV	4,615.73
Calculate down payment.	+/– + 5100 =	484.27

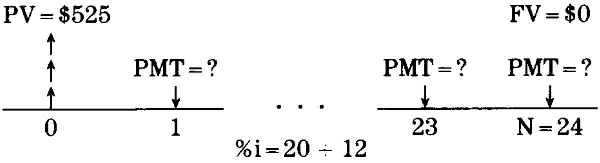
To buy the car, you can borrow $4,615.73 and make a down payment of $484.27.

Amount of Monthly Payment

You are planning to purchase a new small desk and chair set that is sale priced at $525. You can finance your purchase at 20% APR, compounded monthly, for two years. How much is the monthly payment?

Example

The time line for this example is shown below.



Procedure	Press	Display
Clear calculator and mode registers; select two decimal places.	CE/C CE/C 2nd [CMR] 2nd [Fix] 2	0.00
Press MODE until **FIN** is displayed.	MODE	0.00
Press 2nd [BGN] until **Begin** is not displayed.	2nd [BGN]	0.00
Calculate and enter number of monthly payments.	2 2nd [×12] N	24.00
Enter monthly interest rate.	20 2nd [÷12] %i	1.67
Enter loan amount.	525 PV	525.00
Compute payment.	CPT PMT	26.72

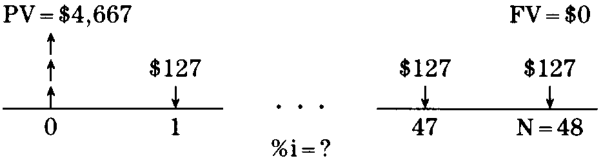
Your monthly payment is $26.72.

Solving for APR and EFF

A pickup truck sells for $4,817. To purchase the truck, you must make a down payment of $150 and 48 monthly payments of $127. The dealer quoted you an APR of 13.77%. Verify this quote and solve for the annual effective rate.

Example

The loan amount (PV) is equal to the cost of the truck minus the down payment.



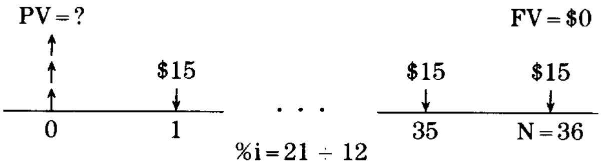
Procedure	Press	Display
Clear calculator and mode registers; select two decimal places.	CE/C CE/C 2nd [CMR] 2nd [Fix] 2	0.00
Press MODE until **FIN** is displayed.	MODE	0.00
Press 2nd [BGN] until **Begin** is not displayed.	2nd [BGN]	0.00
Enter number of monthly payments.	48 N	48.00
Enter payment.	127 PMT	127.00
Calculate and enter loan amount.	4817 − 150 = PV	4,667.00
Compute monthly interest rate.	CPT %i	1.15
Find the APR.	2nd [×12]	13.77
Convert to EFF.	2nd [►EFF] 12 =	14.68

The dealer quoted you the correct APR. The equivalent annual effective rate is 14.68%.

Comparing a Cash Purchase with Time Payments

A salesman will sell you the latest vacuum cleaner for payments of only $15 a month for three years at 21% APR. A store advertises the same vacuum cleaner for $325. Compare the present value of the series of payments to the store's price.

Example The time line for the series of payments is shown below.



Procedure	Press	Display
Clear calculator and mode registers; select two decimal places.	CE/C CE/C 2nd [CMR] 2nd [Fix] 2	0.00
Press MODE until **FIN** is displayed.	MODE	0.00
Press 2nd [BGN] until **Begin** is **not** displayed.	2nd [BGN]	0.00
Calculate and enter number of monthly payments.	3 2nd [×12] N	36.00
Enter monthly interest rate.	21 2nd [÷12] %i	1.75
Enter payment amount.	15 PMT	15.00
Compute present value of payments.	CPT PV	398.14

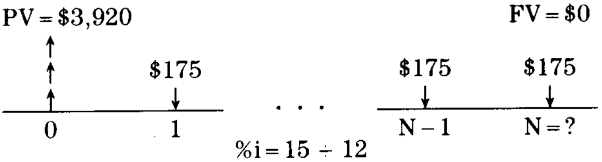
If you buy the vacuum cleaner from the salesman, the present value of the payments is $398.14 (as compared to $325 if you buy it from the store).

Amount of Final Payment

Assume that you borrow $3,920 at 15% APR, compounded monthly, with monthly payments of $175. How many payments do you need to make? How much is the final payment?

Example Part A

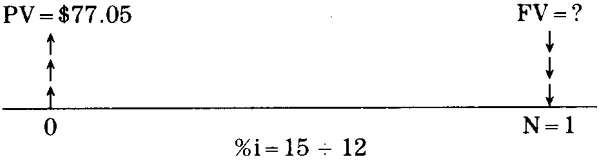
First, compute the total number of payments required. If N is not a whole number, find the loan balance after the last whole-number payment.



Procedure	Press	Display
Clear calculator and mode registers; select two decimal places.	CE/C CE/C 2nd [CMR] 2nd [Fix] 2	0.00
Press MODE until **FIN** is displayed.	MODE	0.00
Press 2nd [BGN] until **Begin** is **not** displayed.	2nd [BGN]	0.00
Enter monthly interest rate.	15 2nd [÷12] %i	1.25
Enter amount of payment.	175 PMT	175.00
Enter loan amount.	3920 PV	3,920.00
Compute number of payments.	CPT N	26.44
Calculate loan balance after 26th payment.	26 BAL	77.05

Part B

Because the loan balance after payment 26 is less than the payment amount, you can find the amount of the final payment by computing the future value of $77.05 after one period of interest.



Procedure	Press	Display
Enter loan balance ($77.05 should be in the display from Part A).	PV	77.05
Enter one for number of periods.	1 N	1.00
Enter zero for payment.	0 PMT	0.00
Compute amount of final payment.	CPT FV	78.01

You need to make a total of 27 payments. Each of the first 26 payments is $175. The final, 27th, payment is $78.01.

Payment Amount on a Deferred Loan

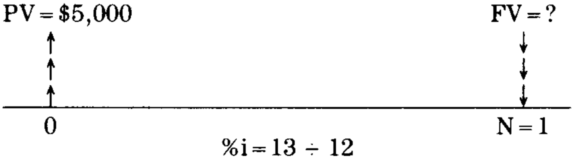
Julie wants to borrow $5,000 at an APR of 13% compounded monthly. Payments are due at the end of each month for 24 months. She wants to make the first payment, deferred one period, two months after the loan origination date. What is her monthly payment?

Example

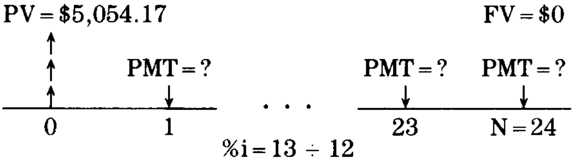
Most loan payments begin one period after the loan is made, and the payment amount is computed accordingly. Occasionally, however, the first payment may be deferred an additional period.

To determine the monthly payment on a deferred loan:

1. Compute the future value of the loan amount after one period. (This assumes that compound interest is used for the deferred interest period.)



2. Enter the computed future value as the new present value. Then compute the payment amount.



Example (Continued)

Procedure	Press	Display
Clear calculator and mode registers; select two decimal places.	CE/C CE/C 2nd [CMR] 2nd [Fix] 2	0.00
Press MODE until **FIN** is displayed.	MODE	0.00
Press 2nd [BGN] until **Begin** is **not** displayed.	2nd [BGN]	0.00
Enter monthly interest rate.	13 2nd [÷12] %i	1.08
Enter loan amount.	5000 PV	5,000.00
Enter number of deferred periods.	1 N	1.00
Compute loan value after the deferred period.	CPT FV	5,054.17
Enter loan value as present value.	PV	5,054.17
Enter zero for FV.	0 FV	0.00
Enter number of payments.	24 N	24.00
Compute deferred payments.	CPT PMT	240.28

If Julie defers her first payment for one month, her monthly payment is $240.28.

Converting Add-On Interest Rates to APR

Your lending institution is loaning a consumer $2,500 for three years. According to state law, the highest rate you can charge is 8% add-on. Calculate the amount of the payment and the equivalent APR.

Example

Some federal regulations require lenders to quote interest rates as APR. States, however, may have usury laws stating interest rate ceilings in terms of add-on interest.

- The total amount of add-on interest paid for a loan is calculated as:

$$\text{add-on interest} = \text{total amount financed} \times \text{add-on rate} \times \text{number of years}$$

where the add-on rate is expressed as a decimal number.

- The amount of each payment, containing both an interest and a principal portion, is calculated as:

$$\text{payment amount} = \left(\text{add-on interest} + \text{total amount financed}\right) \div \text{number of payments}$$

After calculating the payment amount, you can compute the equivalent APR.

Procedure	**Press**	**Display**
Clear calculator and mode registers; select two decimal places.	CE/C CE/C 2nd [CMR] 2nd [Fix] 2	0.00
Press MODE until **FIN** is displayed.	MODE	0.00
Press 2nd [BGN] until **Begin** is **not** displayed.	2nd [BGN]	0.00

Example (Continued)

Procedure	Press	Display
Calculate and enter number of monthly payments.	3 2nd [×12] N	36.00
Enter and store total amount financed.	2500 PV STO	2,500.00
Calculate add-on interest.	× 8 % × 3 =	600.00
Add result to total amount financed.	+ RCL [MEM] =	3,100.00
Calculate and enter monthly payment.	÷ 36 = PMT	86.11
Compute monthly interest rate.	CPT %i	1.21
Find the APR.	2nd [×12]	14.55

The payment amount is $86.11, and the equivalent APR is 14.55%. (Although add-on interest rates often appear to be very low, the equivalent annual rates are quite high.)

Chapter 9: Bonds

This chapter illustrates methods that are commonly used to compute bond price and yield. The examples, however, do not take into account all the factors that may affect the bond market. Bond transactions have historically used a variety of approximations. Therefore, the answers from these methods may not agree exactly with answers you get from other sources.

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Purchasing a Commercial Bond

A bond is a financial obligation made by a corporation or a government agency. The purchaser of a bond receives periodic interest payments, usually semiannually, and receives the face value of the bond on the redemption date.

Interest Payments

The interest payment for each period equals the interest rate printed on the bond (coupon rate) divided by the number of payments per year and multiplied by the face value of the bond. Each six months, for example, a 14% $1,000 semiannual bond pays:

$$\frac{.14}{2} \times \$1{,}000 = \$70$$

The interest payment is also called the coupon payment, because you usually collect it by presenting the company with a printed coupon from a sheet that is part of the bond. In this example, each coupon payment is $70, or 7%. The payment amount and the rate based on the face value are constant.

Premiums/ Discounts

Bonds often sell at prices above or below the face value. A bond selling for an amount greater than the face (or par) value is sold at a premium. A bond priced below par sells at a discount. The actual selling price can differ from the par value for many reasons. For example, a bond was originally sold when 10% was an acceptable return, but 13% is currently required in the market. Therefore, the bond would have to be sold below par (at a discount) to allow for the change in the return required by the market. The return required by the market is called yield.

Yield

More specifically, the yield is the return desired by the buyer. Because the face value of the bond and dollar amount of the coupon payment are fixed, the selling price (present value) of the bond is adjusted to arrive at the yield. Thus, a bond sells at a premium when its coupon rate exceeds the market yield, while a bond sells at a discount if its coupon rate is below the market yield.

Selling Price between Interest Dates—One Coupon Left

A semiannual bond has one remaining coupon payment. You want to buy the bond 145 days after the previous payment. Because there are 183 days in the coupon period, 38 days remain until maturity (183 – 145). The bond's par value is $1,000 with a nominal interest rate of 9%. If you want a 12% yield, what is the purchase price?

Example

Assuming that the final coupon payment is made at redemption, use the following procedure to find the purchase price. (Refer to the formula in Appendix A.) This procedure:

- ► Discounts the sum of the bond's redemption value and the final coupon payment to the purchase date. In this case, the interest is not compounded because the bond will be held for less than six months.
- ► Subtracts the accrued interest due the seller to determine the bond price.

When you enter the redemption value, be sure to enter the value in "points." In other words, a $1,000 bond equals 100 points.

Procedure	Press	Display
Clear calculator and select two decimal places.	CE/C CE/C 2nd [Fix] 2	0.00
Divide redemption value (in points) by 100 and store.	100 ÷ 100 = STO	1.00

(continued)

Example (Continued)

Procedure	Press	Display
Find interest rate per coupon period as a decimal number, and add to memory.	9 [%] [÷] 2 [=] [SUM]	0.05
Enter number of days until coupon payment and divide by number of days in coupon period.	38 [÷] 183 [=]	0.21
Multiply by desired yield, divide by number of coupon payments per year, and add 1.	[×] 12 [%] [÷] 2 [+] 1 [=]	1.01
Find reciprocal and multiply by value in memory to calculate bond price per dollar, including accrued interest; store result.	[2nd] [1/x] [×] [RCL] [MEM] [=] [STO]	1.03
Enter number of days of accrued interest and divide by number of days in coupon period.	145 [÷] 183 [=]	0.79

Example (Continued)

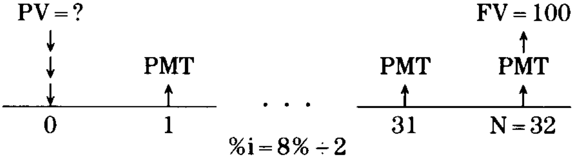
Procedure	Press	Display
Multiply by annual interest rate and divide by number of coupon payments per year to calculate accrued interest per dollar.	[×] 9 [%] [÷] 2 [=]	0.04
Subtract result from value stored in memory to calculate price of bond per dollar, without accrued interest.	[+/−] [+] [RCL] [MEM] [=]	1.00
Multiply by 100 to calculate price of bond per $100.	[×] 100 [=]	99.65

To yield 12%, the price of the bond should be $99.65 per $100.

A semiannual bond has 33 remaining coupon payments, with 183 days in each coupon period. You want to buy the bond 106 days after the previous coupon payment. The bond's par value is $1,000 with a nominal interest rate of 7%. If you want an 8% yield, what is the bond's price both before and after the accrued interest is deducted?

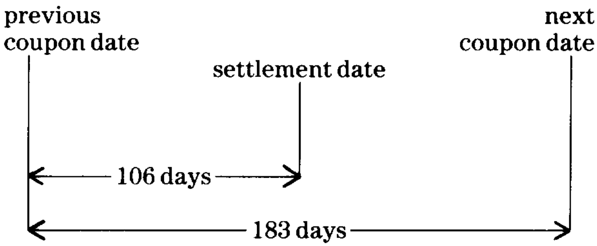
Example To calculate the price of the bond at the settlement date, use the following procedure. (Be sure to enter the bond's value in "points." In other words, a $1,000 bond equals 100 points.)

1. For the next coupon date, compute the PV of the redemption value and the remaining coupon payments. After the next coupon date, there will be only 32 remaining payments. (Refer to page 9-2 for information on coupon payments.)



2. Add the amount of the coupon payment. This gives the total present value of the bond on the next coupon date.

3. Discount the result back to the settlement date. This gives the purchase price of the bond including accrued interest.



4. Calculate the accrued interest and subtract it from the computed price. This gives the purchase price of the bond excluding the accrued interest.

Example (Continued

Procedure	Press	Display
Clear calculator and mode registers; select two decimal places.	CE/C CE/C 2nd [CMR] 2nd [Fix] 2	0.00
Press MODE until **FIN** is displayed.	MODE	0.00
Press 2nd [BGN] until **Begin** is **not** displayed.	2nd [BGN]	0.00
Calculate and enter desired periodic yield.	8 ÷ 2 = %i	4.00
Subtract 1 from current number of remaining coupon payments, and enter result.	33 − 1 = N	32.00
Calculate and enter amount of coupon payment (in points).	7 % + 2 × 100 = PMT	3.50

(continued)

Example (Continued)

Procedure	Press	Display
Enter par or redemption value (in points).	100 [FV]	100.00
Compute present value.	[CPT] [PV]	91.06
Add amount of coupon payment (previously calculated), and store.	[+] 3.5 [=] [STO]	94.56
Calculate and enter portion of coupon period remaining after settlement date (number of days in coupon period − accrued interest days ÷ number of days in period).	183 [−] 106 [÷] 183 [=] [N]	0.42
Compute present value of bond at settlement date, including accrued interest.	0 [PMT] [RCL] [MEM] [FV] [CPT] [PV]	93.02

Example (Continued)

Procedure	Press	Display
Calculate amount of accrued interest due the seller (amount of coupon payment × number of days of accrued interest ÷ number of days in period).	3.5 [×] 106 [÷] 183 [=]	2.03
Subtract result from present value of bond (calculated previously) to find bond value excluding accrued interest.	[+/−] [+] [RCL] [PV] [=]	90.99

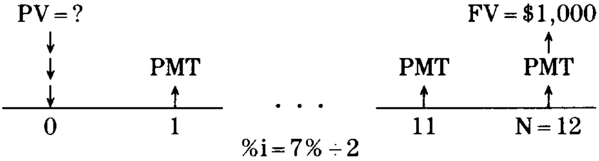
The bond's price is $93.02 per $100 before the accrued interest is deducted and $90.99 per $100 after the interest is deducted.

Selling Price on an Interest Date—More Than One Coupon Left

You are considering the purchase of a commercial bond as an investment. If you hold the bond to maturity, you want it to yield 7% interest compounded semiannually. Otherwise, you won't invest. If the par value is $1,000, how much should you pay for a 4% semiannual bond that matures in six years?

Example

Before you can compute the bond price, you need to calculate the coupon payment. (Refer to page 9–2 for information on calculating the amount of the coupon payment.)



Procedure	Press	Display
Clear calculator and mode registers; select two decimal places.	CE/C CE/C 2nd [CMR] 2nd [Fix] 2	0.00
Press MODE until **FIN** is displayed.	MODE	0.00
Press 2nd [BGN] until **Begin** is **not** displayed.	2nd [BGN]	0.00
Calculate and enter required yield per coupon period.	7 ÷ 2 = %i	3.50

Example (Continued)

Procedure	Press	Display
Calculate and enter number of coupon payments.	6 [×] 2 [=] [N]	12.00
Calculate and enter amount of coupon payment.	4 [%] [÷] 2 [×] 1000 [=] [PMT]	20.00
Enter face value of bond.	1000 [FV]	1,000.00
Compute bond price.	[CPT] [PV]	855.05

The maximum purchase price of the bond is $855.05. If you can buy the bond for less, the yield will be higher than your desired rate. If you have to pay more, the yield will be lower.

Yield to Maturity on a Bond Purchased on an Interest Date

A 9% $1,000 semiannual commercial bond has 13 remaining coupon payments. You can purchase the bond for $852.50 (ignoring commissions). At this price, what is your yield to maturity and the annual effective rate?

Example

Procedure	Press	Display
Clear calculator and mode registers; select two decimal places.	CE/C CE/C 2nd [CMR] 2nd [Fix] 2	0.00
Press MODE until **FIN** is displayed.	MODE	0.00
Press 2nd [BGN] until **Begin** is **not** displayed.	2nd [BGN]	0.00
Enter number of remaining coupon payments.	13 N	13.00
Enter bond price.	852.5 PV	852.50
Enter annual coupon rate and calculate coupon payment.	9 % ÷ 2 × 1000 = PMT	45.00
Enter bond redemption value.	1000 FV	1,000.00

Example (Continued)

Procedure	Press	Display
Compute semiannual yield.	CPT %i	6.18
Calculate annual yield to maturity with semiannual compounding.	× 2 =	12.37
Convert to annual effective rate.	2nd [►EFF] 2 =	12.75

The annual yield to maturity is 12.37% with semiannual compounding. The equivalent annual effective rate is 12.75%.

Amortizing a Bond Premium or Discount (Effective Interest Method)

The JA Company has issued $100,000 worth of bonds for $93,204.84. The bonds mature in ten years and have a nominal rate of 7% with a semiannual coupon. The effective interest rate or yield is 8%. Calculate the bond interest, discount, and balance after interest for coupon periods 1 and 10.

Example

With the effective interest method, the bond interest expense is equal to the effective interest rate times the bond book value. The cash paid out is equal to the nominal interest rate times the par value.

The difference between the interest expense and the cash payment is the bond premium or discount. This amount is added to the bond book value if it is a discount and is subtracted from the book value if it is a premium. The adjusted book value is used to compute the interest expense for the next period.

Procedure	Press	Display
Clear calculator and mode registers; select two decimal places.	CE/C CE/C 2nd [CMR] 2nd [Fix] 2	0.00
Press MODE until **FIN** is displayed.	MODE	0.00
Press 2nd [BGN] until **Begin** is **not** displayed.	2nd [BGN]	0.00
Calculate and enter periodic yield.	8 ÷ 2 = %i	4.00
Enter bond cost.	93204.84 PV	93,204.84

Example (Continued)

Procedure	Press	Display
Calculate and enter coupon payment.	7 [%] [÷] 2 [×] 100000 [=] [PMT]	3,500.00
Calculate and enter number of coupon payments.	10 [×] 2 [=] [N]	20.00
Calculate bond interest expense after coupon period 1.	1 [I/P]	3,728.19
Calculate bond discount (negative answer) or premium (positive value).	[x⇆y]	– 228.19
Compute net book value at end of period 1.	1 [BAL]	93,433.03
Repeat for period 10.		
a. Interest	10 [I/P]	3,824.79
b. Discount or premium	[x⇆y]	– 324.79
c. Net book value	10 [BAL]	95,944.56

You can repeat this procedure for any of the coupon periods.

Equivalent Taxable Yield on Tax-Free Bonds

You are currently in a 45% income-tax bracket and are considering buying a 6% tax-free yield municipal bond. What taxable yield would you have to earn to get the same amount after taxes?

Example

Procedure	Press	Display
Clear calculator and select two decimal places.	CE/C CE/C 2nd [Fix] 2	0.00
Find nontaxable income rate (100 – income tax bracket).	100 − 45 =	55.00
Convert to decimal number, and store.	% STO	0.55
Find equivalent taxable yield (municipal bond rate ÷ nontaxable income rate).	6 ÷ RCL [MEM] =	10.91

The equivalent taxable yield is 10.91%.

Equivalent Tax-Free Yield on Taxable Bonds

You currently own a taxable bond that pays 10% dividends, and you are in a 38% income-tax bracket. To get the same return on a tax-free bond, what dividend rate would you need to earn?

Example

Procedure	Press	Display
Clear calculator and select two decimal places.	[CE/C] [CE/C] [2nd] [Fix] 2	0.00
Enter 100 and subtract income tax bracket.	100 [−] 38 [=]	62.00
Convert result to a decimal number.	[%]	0.62
Multiply by taxable yield to calculate equivalent tax-free yield.	[×] 10 [=]	6.20

You would need to earn an annual dividend rate of 6.2% on a tax-free bond.

Chapter 10: Pricing and Profit

This chapter helps you solve some of the more common types of pricing and profit problems. With the calculator's business functions, you can perform markup/markdown and gross profit margin calculations. You can also solve problems involving sales tax.

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Sales Tax and Price

You are buying a new sorting machine from a business supply store and have agreed on a price of $4,632, plus 4% sales tax. What is the total selling price, and how much is the sales tax?

Example

Procedure	Press	Display
Clear calculator and mode registers; select two decimal places.	CE/C CE/C 2nd [CMR] 2nd [Fix] 2	0.00
Press MODE until no mode indicator is displayed.	MODE	0.00
Enter cost (without sales tax).	4632 CST	4,632.00
Enter tax rate as a markup.	4 2nd [MU]	4.00
Compute selling price (cost plus tax).	CPT SEL	4,817.28
Subtract cost to calculate amount of sales tax.	− RCL CST =	185.28

The total selling price is $4,817.28, which includes a sales tax of $185.28.

Discounts and Selling Prices

You want to buy a lawn mower that regularly costs $239.45. However, a store near your home is selling the lawn mower at a 15% discount. What is the selling price?

Example

Procedure	Press	Display
Clear calculator and mode registers; select two decimal places.	CE/C CE/C 2nd [CMR] 2nd [Fix] 2	0.00
Press MODE until no mode indicator is displayed.	MODE	0.00
Enter regular cost.	239.45 CST	239.45
Enter discount (markdown) percent as a negative number.	15 +/- 2nd [MU]	-15.00
Compute selling price.	CPT SEL	203.53

The selling price of the lawn mower is $203.53.

Markups and Selling Prices

A grocery store manager has purchased a load of bananas for $0.21 per pound. If the standard markup is 20% of cost, what is the selling price of the bananas?

Example

Procedure	Press	Display
Clear calculator and mode registers; select two decimal places.	[CE/C] [CE/C] [2nd] [CMR] [2nd] [Fix] 2	0.00
Press [MODE] until no mode indicator is displayed.	[MODE]	0.00
Enter cost per pound.	.21 [CST]	0.21
Enter markup percent.	20 [2nd] [MU]	20.00
Compute selling price.	[CPT] [SEL]	0.25

The store sells the bananas at $0.25 per pound.

Selling Price Necessary to Earn a Specified GPM

You need to determine the retail price for an item that cost your store $22.50. If you require a 35% gross profit margin on sales, what should the retail price be?

Example

Procedure	Press	Display
Clear calculator and mode registers; select two decimal places.	CE/C CE/C 2nd [CMR] 2nd [Fix] 2	0.00
Press MODE until no mode indicator is displayed.	MODE	0.00
Enter your cost.	22.5 CST	22.50
Enter gross profit margin.	35 MAR	35.00
Compute selling price.	CPT SEL	34.62

The retail price should be $34.62.

Dealer's Cost, Based on GPM

A new compact car on a showroom floor has a base sticker price of $5,100. You read in a consumer magazine that compacts are generally priced to provide the dealer about a 17% margin on the selling price. If this report is correct, how much did the car cost the dealer?

Example

Procedure	Press	Display
Clear calculator and mode registers; select two decimal places.	CE/C CE/C 2nd [CMR] 2nd [Fix] 2	0.00
Press MODE until no mode indicator is displayed.	MODE	0.00
Enter selling price.	5100 SEL	5,100.00
Enter margin percent.	17 MAR	17.00
Compute cost.	CPT CST	4,233.00

Assuming a 17% margin, the dealer's cost is $4,233.

Chapter 11: Business Finance and Business Statistics

This chapter describes a method used to evaluate long-term investments that involve a series of variable cash flows. It also includes some common business applications that use statistics.

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Modified Financial Management Rate of Return

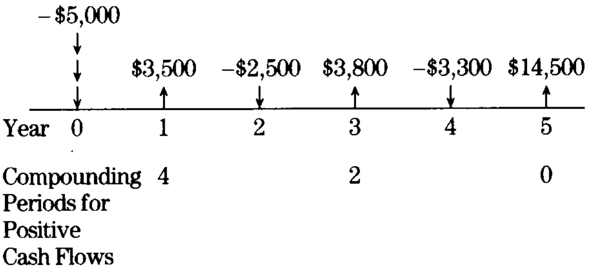
Your company is evaluating a $5,000 investment with a five-year life. You require an annual earnings rate of 20%. The projected after-tax cash flows are shown below. You intend to fund the negative cash flows by investing in a savings account that pays 5.5% compounded annually. What is the modified financial management rate of return (FMRR)?

Example

The after-tax cash flows for each year are:

Year	Cash Flow
1	$3,500
2	–2,500
3	3,800
4	–3,300
5	14,500

These cash flows, along with the initial investment, are shown on the following time line.



The modified FMRR method is often used when there are multiple negative cash flows. To use this method, you need to:

- Calculate the sum of the present values of the negative cash flows. (This is the amount necessary to fund the negative cash flows.) Then add the result to the initial cash outlay to find the total present value.

- Calculate the sum of the future values of the positive cash flows by compounding them forward to the end of the investment's life. (The time line above shows the number of compounding periods for the positive cash flows.)

Example (Continued)

Procedure	Press	Display
Clear calculator and mode registers; select two decimal places.	CE/C CE/C 2nd [CMR] 2nd [Fix] 2	0.00
Press MODE until **FIN** is displayed.	MODE	0.00
Press 2nd [BGN] until **Begin** is **not** displayed.	2nd [BGN]	0.00
Enter annual interest rate for savings account.	5.5 %i	5.50
Enter period of first negative cash flow.	2 N	2.00
Enter amount of first negative cash flow.	2500 FV	2,500.00
Compute present value of first negative cash flow and store.	CPT PV STO	2,246.13

(continued)

Example (Continued)

Procedure	Press	Display
Repeat for each negative cash flow.		
a. Enter period of next negative cash flow.	4 [N]	4.00
b. Enter amount.	3300 [FV]	3,300.00
c. Compute present value and sum to memory.	[CPT] [PV] [SUM]	2,663.82
Recall sum of present values of negative cash flows.	[RCL] [MEM]	4,909.95
Add initial cash outlay to find total present value.	[+] 5000 =	9,909.95
Enter required earnings rate.	20 [%i]	20.00
Compute future value of positive cash flows.		
a. First positive cash flow (with 4 compounding periods)	4 [N] 3500 [PV] [CPT] [FV] [STO]	7,257.60

Example (Continued)

Procedure	Press	Display
b. Next positive cash flow (with 2 compounding periods)	2 [N] 3800 [PV] [CPT] [FV] [SUM]	5,472.00
c. Next positive cash flow (with no compounding periods)	14500 [SUM]	14,500.00
Recall sum of future values of positive cash flows, and enter as future value.	[RCL] [MEM] [FV]	27,229.60
Enter total number of periods (years).	5 [N]	5.00
Re-enter total present value (calculated previously), and enter as present value.	9909.95 [PV]	9,909.95
Compute modified FMRR.	[CPT] [%i]	22.40

The modified financial management rate of return is 22.40%, which exceeds the required return rate of 20%.

Learning-Curve Analysis

A company has started a new product line and has made the observations shown below. Use a learning-curve analysis to see if the labor hours per unit decline as the company gains experience in making the product. If so, what is the learning rate and how many hours did it take to produce the first unit?

Example The company's observations are:

Cumulative Units Produced (x)	**Average Cumulative Labor Hours Per Unit (y)**
50	31
80	24
100	22
125	19.5
160	17.3

Learning-curve analysis can predict whether the number of units produced affects the cumulative average time required to produce each unit. You can determine the average number of labor hours (y) needed to produce x cumulative units by using the equation:

$$y = bx^a$$

where b = number of labor hours needed to produce the first unit
x = number of units produced
a = learning-rate factor, which is expressed as the ratio of natural logarithms:

$$\frac{\ln(\text{learning rate})}{\ln(2)}$$

The total number of hours needed to produce x units is expressed as:

$$yx = bx^{a+1}$$

The incremental hours needed to produce the xth unit is expressed as:

$$\text{man-hours} = b(a+1)x^a$$

Example (Continued)

Using the equation $y = bx^a$, take the natural logarithm of both sides.

$\ln(y) = \ln(b) + a \times \ln(x)$

This can be plotted as a straight line, where "ln(b)" is the y-intercept of the line and "a" is the slope.

To solve this example, enter the natural logarithm of the observed x and y data points. Then use linear regression to analyze the points.

- The time needed to produce the first unit (b) equals the natural antilogarithm of the y-intercept of the regression line.
- The learning-rate factor (a) equals the slope.

Procedure	Press	Display
Clear calculator and mode registers; select two decimal places.	CE/C CE/C 2nd [CMR] 2nd [Fix] 2	0.00
Press MODE until **STAT** is displayed.	MODE	0.00
Enter first pair of x and y values.	50 2nd [lnx] x⇆y 31 2nd [lnx] Σ+	1.00
Enter second pair.	80 2nd [lnx] x⇆y 24 2nd [lnx] Σ+	2.00

(continued)

Example (Continued)

Procedure	Press	Display
Enter third pair.	100 2nd [lnx] x⇆y 22 2nd [lnx] Σ+	3.00
Enter fourth pair.	125 2nd [lnx] x⇆y 19.5 2nd [lnx] Σ+	4.00
Enter fifth pair.	160 2nd [lnx] x⇆y 17.3 2nd [lnx] Σ+	5.00
Find correlation.	2nd [Corr]	– 1.00
Find hours for first unit.	2nd [b/a] 2nd [e^x]	216.17
Find learning-rate factor.	x⇆y	– 0.50
Calculate learning rate as a percentage.	× 2 2nd [lnx] = 2nd [e^x] × 100 =	70.81

The correlation value of – 1 indicates a good negative relationship. (As x values increase, y values decrease proportionally.) The learning rate is 70.81%, and the time needed to produce the first unit was 216.17 hours.

In this example, the average cumulative value is 31 hours per unit for the first 50 units produced. For 100 units (2 × 50), the average cumulative value is 22 hours (31 × 70.81% = 21.95 hours).

Note: This example uses one of two models commonly used for learning-curve analysis. The other model is more appropriate for engineering applications.

Estimating Costs with Linear Regression Analysis

As the number of direct labor hours increases, your company's overhead manufacturing costs also increase. Use the data below to predict the total overhead costs and the variable overhead costs within the normal production range of 4,000 to 6,000 hours.

Example

The following data is a sample of the number of labor hours worked and the actual manufacturing overhead incurred for the last 12 months.

Month	Direct Labor Hours (x)	Manufacturing Overhead ($y)
1	4,000	21,050
2	4,500	24,010
3	5,000	24,800
4	5,200	25,820
5	5,600	26,730
6	6,000	28,150
7	5,500	26,585
8	4,900	24,640
9	4,700	24,030
10	4,500	23,595
11	4,400	23,104
12	4,200	22,440

Perform a linear regression analysis on this data to:

- Develop an overhead cost equation.
- Determine the variable overhead rate per hour.
- Estimate the total overhead for 5,400 hours of direct labor.

In addition, use the formulas in Appendix A to evaluate the accuracy of the cost equation by calculating the:

- Correlation coefficient.
- Index of determination.
- Standard error of the equation.
- Standard error of the variable overhead rate estimate.

(continued)

Example (Continued)

Procedure	Press	Display
Clear calculator and mode registers; select two decimal places.	CE/C CE/C 2nd [CMR] 2nd [Fix] 2	0.00
Press MODE until **STAT** is displayed.	MODE	0.00
Enter data. (Display shows current number of data entries.)		
Enter first pair of x and y data points.	4000 x⇄y 21050 Σ+	1.00
Enter second pair of data points.	4500 x⇄y 24010 Σ+	2.00
Continue to enter data pairs from table on previous page.	⋮	
Enter twelfth pair of data points.	4200 x⇄y 22440 Σ+	12.00
Find y-intercept.	2nd [b/a]	8,770.88
Find slope (variable overhead rate).	x⇄y	3.24

Example (Continued)

Procedure	Press	Display
Find correlation coefficient (r).	2nd [Corr]	0.99
Calculate and store index of determination (r^2).	2nd [x^2]	
	STO	0.98
Find standard error of regression line, based on N = 12 pairs of data points.	1 −	
	RCL [MEM]	
	= STO	0.02
	2nd [σn]	
	2nd [x^2] ×	
	RCL [MEM]	
	× 12 = STO	1,073,643.29
	12 − 2 =	
	2nd [1/x] ×	
	RCL [MEM]	
	= 2nd [$\sqrt{x}$]	
	STO	327.66
Find standard error of slope, based on N = 12 pairs of data points.	2nd [σn] x⇆y	
	2nd [x^2]	
	× 12 =	
	2nd [$\sqrt{x}$]	2,015.56
	2nd [1/x] ×	
	RCL [MEM] =	0.16
Estimate y value (overhead) for x = 5,400 hours.	5400	
	2nd [y']	26,281.97

(continued)

Example (Continued)

The variable overhead rate is $3.24 per hour, and the y-intercept of the line is $8,770.88. Use these values to get the equation for the manufacturing overhead:

Overhead cost = 3.24 (Direct labor hours) + 8,770.88

Because the index of determination (0.98) is close to one, you can assume that the equation is a good predictor of the data points within the range of 4,000 to 6,000 hours. (An index of determination close to zero would indicate that the equation is not a good predictor.)

The value for the standard error of the regression line, $327.66, means that the actual overhead costs usually equal the estimated costs ± 2 × $327.66. The smaller the standard error, the more accurate your estimate.

The standard error of the slope (.16) indicates that the actual variable overhead rate usually equals $3.24 ± (2 × .16). The smaller this error value, the more accurate your estimate.

For 5,400 hours of direct labor, the equation predicts a total overhead amount of $26,281.97. By applying the standard error of the regression line, the actual amount would usually fall within the range of:

$26,281.97 ± 2 × $327.66

or

25,626.65 to $26,937.29.

Appendix A: Reference Information

This appendix provides supplemental information that may be helpful as you use your BA-SOLAR financial calculator.

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Formulas

Both the formulas used internally by your calculator and the formulas needed to solve specific examples are included here for your information.

Compound Interest

$$FV = PV\,(1+i)^N \qquad (PMT = 0)$$

Present Value of an Annuity

$$PV = \left[1 + \frac{\%i}{100} \times K\right] \times PMT \left[\frac{1-\left(1+\frac{\%i}{100}\right)^{-N}}{\frac{\%i}{100}}\right] + FV\left[1+\left(\frac{\%i}{100}\right)^{-N}\right]$$

where:

K = 0 if PMT occurs at the end of each payment period (ordinary annuity)
K = 1 if PMT occurs at the beginning of each payment period (annuity due)

Note: If the payment is positive, the interest is discounted. If the payment is negative, the interest is compounded.

Converting APR to EFF

$$EFF = \left[\left(1 + \frac{APR/100}{c/yr}\right)^{c/yr} - 1\right] \times 100$$

where c/yr = number of compounding periods per year for APR

Converting EFF to APR

$$APR = \left[\left(1 + \frac{EFF}{100}\right)^{1/c/yr} - 1\right] \times c/yr \times 100$$

where c/yr = number of compounding periods per year for APR

Interest/ Principal

The principal balance for M periods is:

$$BAL(M) = PMT \times \left[\frac{1-(1+i)^{-N+M}}{i} \right]$$

The accrued interest for M periods is:

$$ACC(M) = M \times PMT + BAL(M) - PV$$

The amount of interest in the Mth payment is:

$$I(M) = BAL(M-1) \times i$$

The amount of principal in the Mth payment is:

$$P(M) = PMT - BAL(M-1) \times i$$

Interest Rate Conversions: Compound Interest

Converting a continuous rate to a discrete rate:

$$i = e^{r} - 1$$

Converting a discrete rate to a continuous rate:

$$r = \ln(1+i)$$

where i = equivalent discrete interest rate per compounding period as a decimal
r = continuous interest rate per compounding period as a decimal

Interest Rate Conversions: Annuities

Converting a continuous rate to a discrete rate:

$$i = e^{r/f} - 1$$

Converting a discrete rate to a continuous rate:

$$r = \ln(1+i) \times f$$

where i = equivalent discrete interest rate per payment period as a decimal
r = annual continuous rate as a decimal
f = number of payments per year

(continued)

Rule of 78's Interest Amortization

Total finance charge = N × PMT – loan amount

Amount of interest in Kth payment =

$$\frac{N-K+1}{\text{sum-of-the-years'-digits}} \times \text{total finance charge}$$

where sum-of-the-years'-digits $= \frac{N(N+1)}{2}$

Unearned interest rebate after K payments =

$$\frac{(N-K)(N-K+1)}{N(N+1)} \times \text{total finance charge}$$

Amount of interest paid in K payments =

total finance charge – interest rebate

Amount required to pay off loan after Kth payment =

loan amount + amount of interest paid in K payments – K × PMT

where:

N = total number of payments
PMT = periodic payment amount
K = number of current payment

Bonds

Purchase price of a bond sold between interest dates (**more than one** coupon left; daily interest periods are assumed for accrued interest):

$$PV = \left[(1+Y_i)^{-\left(\frac{TD-AD}{TD}\right)}\left[\left(CPN + \left(CPN \times \left(\frac{1-(1+Y_i)^{-(n-1)}}{Y_i}\right)\right)\right) + RV(1+Y_i)^{-(n-1)}\right]\right] - \left(\frac{AD}{TD} \times CPN\right)$$

Purchase price of a bond sold between interest dates (**one** coupon payment left; daily interest periods are assumed for accrued interest):

$$PV = \left[\frac{RV + CPN}{1 + \left(\frac{RD}{TD} \times Y_i\right)}\right] - \left[\frac{AD}{TD} \times CPN\right]$$

where:

PV = present value of the bond on the settlement day
RV = redemption value of the bond
CPN = coupon payment per period in dollars
Y_i = yield per coupon period as a decimal
n = number of coupon payments remaining
RD = number of days from the settlement date to the next coupon payment
AD = number of days from the last coupon payment to the settlement date
TD = total number of days in the coupon period

(continued)

Depreciation Expense

In the following formulas, N = life of asset (in years).

$$\text{Straight-line} = \frac{\text{cost} - \text{salvage}}{\text{N}}$$

Sum-of-the-years'-digits (SYD) =

$$\frac{\text{cost} - \text{salvage}}{\text{sum-of-the-years'-digits}} \times (\text{N} + 1 - \text{year number})$$

$$\text{where sum-of-the-years'-digits} = \frac{\text{N}(\text{N}+1)}{2}$$

Declining balance =

$$\text{net book value} \times \frac{\text{declining balance factor}}{\text{N}}$$

where depreciation stops when the net book value equals the salvage value.

Statistics

Standard deviation with n weighting =

$$\left[\frac{\Sigma x^2 - \frac{(\Sigma x)^2}{n}}{n}\right]^{1/2}$$

Standard deviation with n − 1 weighting =

$$\left[\frac{\Sigma x^2 - \frac{(\Sigma x)^2}{n}}{n-1}\right]^{1/2}$$

Variance = σ^2

Mean = $\overline{x} = \frac{(\Sigma x)}{n}$

Linear Regression

Slope (a) = $\frac{n(\Sigma xy) - (\Sigma y)(\Sigma x)}{n(\Sigma x^2) - (\Sigma x)^2}$

Y-intercept (b) = $\frac{\Sigma y - a\Sigma x}{n}$

Correlation coefficient (r) = $\frac{a\sigma_x}{\sigma_y}$

Standard error of the regression line =

$$S_{y/x} = \left[(1-r)^2 \sigma_y{}^2 \times n \times \frac{1}{n-2}\right]^{1/2}$$

Standard error of slope =

$$S_b = \frac{S_{y/x}}{(\sigma_x{}^2 \times n)^{1/2}}$$

Error Conditions

When an error condition occurs, the word "Error" appears in the display. The calculator will not accept a keyboard entry until you press CE/C or AC/ON to clear the error condition. (Pressing CE/C twice clears the condition and all pending operations; pressing AC/ON clears the calculator completely.)

General Error Conditions

The following error conditions can occur in all modes. These errors occur when you attempt to:

1. Calculate a result that is outside the range $-9.999999999 \times 10^{99}$ to -1×10^{-99}, zero, or 1×10^{-99} to $9.999999999 \times 10^{99}$.
2. Divide a number by zero.
3. Calculate 2nd [lnx] or 2nd [1/x] of zero.
4. Calculate 2nd [Δ%] for an old value equal to zero.
5. Calculate 2nd [$\sqrt{x}$], 2nd [lnx], or 2nd [y^x] of a negative number.
6. Use 2nd [y^x] to raise zero to the power of zero.
7. Press a key or key sequence that cannot be performed in the calculator's current mode.

Financial Error Conditions

The following error conditions occur only when the calculator is in the financial mode. These errors occur when you attempt to:

1. Calculate a financial unknown before you have entered enough known variables or when no solution exists.
2. Calculate a financial value greater than or equal to $\pm 1 \times 10^{10}$ (except for N).
3. Use 2nd [►APR] or 2nd [►EFF] when the number of compounding periods per year is zero or very large, or when %i is small.
4. Compute the balance or interest for a payment number less than zero.

Statistics Error Conditions

The error conditions listed in this section occur only when the calculator is in the statistics mode. These errors occur when you attempt to:

1. Use $\boxed{\Sigma+}$ to enter a data point (x or y) such that $|x| > 1 \times 10^{50}$.
2. Press $\boxed{\text{2nd}}$ [Σ−] when there are no data points in the statistical registers or when there is only one data point in the statistical registers.
3. Calculate $\boxed{\text{2nd}}$ [σ_{n-1}] with only one data point.
4. Perform a statistical calculation when there are no data points.
5. Perform a linear regression calculation with less than two data points.
6. Calculate the y-intercept/slope of a vertical line.
7. Enter a series of data values such that the sum of their squares exceeds the upper or lower limit of the calculator.

Accuracy Information

Internally, the calculator stores results as 13-digit numbers. In the display, however, results are rounded to 10 digits. The extra internal digits, called "guard" digits, increase the calculator's accuracy. Any subsequent calculations are performed on the internal value, not on the value in the display.

Rounding

If a calculation produces an 11-digit (or greater) fractional result, the calculator uses the internal guard digits to determine how to display the result.

If the eleventh digit of the result is 5 or greater, the calculator automatically rounds the result to the next larger value for display.

For example, consider the following problem.

$1 \div 3 \times 3 = ?$

Internally, the calculator solves the problem in two steps, as shown below.

1. $1 \div 3 = 0.333333333333$
2. $0.333333333333 \times 3 = 0.999999999999$

The calculator rounds the result and displays it as 1. This rounding enables the calculator to display the most accurate result.

Most calculations are accurate to within ± 1 in the last displayed digit. However, the higher-order mathematical functions use iterative calculations, and inaccuracies can accumulate in the guard digits. In most cases, the cumulative error from these calculations is maintained beyond the 10-digit display so that no inaccuracy is shown.

Appendix B: Service and Warranty Information

This appendix describes routines that may help you correct any problems in using your BA-SOLAR calculator, as well as the service and warranty provided by Texas Instruments.

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In Case of Difficulty

If you have difficulty operating the calculator, you may be able to correct the problem without returning the calculator for service. The following table lists several problems and possible solutions. If these solutions do not correct the problem, refer to "Service Information" later in this appendix.

Possible Solutions

Difficulty	Solution
Display is blank; digits do not appear.	The display goes blank during a long calculation. If a calculation is in progress, wait for it to finish. Be sure the solar power cells are exposed to an adequate light source.
Profit margin, markup, financial, or statistics functions do not seem to work.	Be sure the calculator is in the correct mode—profit margin, financial, or statistics.
The calculator does not display the number of decimal digits that you expect.	Be sure the calculator is set (fixed) for the number of decimal digits that you want.
An error occurs.	Check the error conditions listed in Appendix A.

If you experience difficulties other than those listed above, press AC/ON to clear the calculator, and then repeat your calculations.

- Be sure to set the calculator for the correct mode—profit margin, FIN, or STAT.
- Be sure the display is set to the correct format—floating decimal or fixed decimal.
- Review the operating instructions to be sure that you are performing the calculations correctly.

Support and Service Information

Product Support

Customers in the U.S., Canada, Puerto Rico, and the Virgin Islands

For general questions, contact Texas Instruments Customer Support:

phone: **1-800-TI-CARES (1-800-842-2737)**
e-mail: **ti-cares@ti.com**

For technical questions, call the Programming Assistance Group of Customer Support:

phone: **1-972-917-8324**

Customers outside the U.S., Canada, Puerto Rico, and the Virgin Islands

Contact TI by e-mail or visit the TI **calculator** home page on the World Wide Web.

e-mail: **ti-cares@ti.com**
Internet: **www.ti.com/calc**

Product Service

Customers in the U.S. and Canada Only

Always contact Texas Instruments Customer Support before returning a product for service.

Customers outside the U.S. and Canada

Refer to the leaflet enclosed with this product or contact your local Texas Instruments retailer/distributor.

Other TI Products and Services

Visit the TI **calculator** home page on the World Wide Web.

www.ti.com/calc

Refer to the leaflet enclosed with this product or contact your local Texas Instruments retailer/distributor.

Customers in the U.S. and Canada Only

One-Year Limited Warranty for Electronic Product

This Texas Instruments ("TI") electronic product warranty extends only to the original purchaser and user of the product.

Warranty Duration. This TI electronic product is warranted to the original purchaser for a period of one (1) year from the original purchase date.

Warranty Coverage. This TI electronic product is warranted against defective materials and construction. **THIS WARRANTY IS VOID IF THE PRODUCT HAS BEEN DAMAGED BY ACCIDENT OR UNREASONABLE USE, NEGLECT, IMPROPER SERVICE, OR OTHER CAUSES NOT ARISING OUT OF DEFECTS IN MATERIALS OR CONSTRUCTION.**

Warranty Disclaimers. ANY IMPLIED WARRANTIES ARISING OUT OF THIS SALE, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, ARE LIMITED IN DURATION TO THE ABOVE ONE-YEAR PERIOD. TEXAS INSTRUMENTS SHALL NOT BE LIABLE FOR LOSS OF USE OF THE PRODUCT OR OTHER INCIDENTAL OR CONSEQUENTIAL COSTS, EXPENSES, OR DAMAGES INCURRED BY THE CONSUMER OR ANY OTHER USER.

Some states/provinces do not allow the exclusion or limitation of implied warranties or consequential damages, so the above limitations or exclusions may not apply to you.

Legal Remedies. This warranty gives you specific legal rights, and you may also have other rights that vary from state to state or province to province.

Warranty Performance. During the above one (1) year warranty period, your defective product will be either repaired or replaced with a reconditioned model of an equivalent quality (at TI's option) when the product is returned, postage prepaid, to Texas Instruments Service Facility. The warranty of the repaired or replacement unit will continue for the warranty of the original unit or six (6) months, whichever is longer. Other than the postage requirement, no charge will be made for such repair and/or replacement. TI strongly recommends that you insure the product for value prior to mailing.

Software. Software is licensed, not sold. TI and its licensors do not warrant that the software will be free from errors or meet your specific requirements. **All software is provided "AS IS."**

Copyright. The software and any documentation supplied with this product are protected by copyright.

All Customers Outside the U.S. and Canada

For information about the length and terms of the warranty, refer to your package and/or to the warranty statement enclosed with this product, or contact your local Texas Instruments retailer/distributor.

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